

"By far the best book on the subject."—Field & Stream

MEDICINE FOR THE OUTDOORS

THE ESSENTIAL GUIDE TO
FIRST AID AND MEDICAL EMERGENCIES
FIFTH EDITION

Paul S. Auerbach, MD



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"When a crisis occurs in the backcountry, punching in 911 may not even get you a dial tone — you're on your own. This book is your wilderness 911. Take the time to read it and know the principles of care provided within it. Medicine for the Outdoors just might save your life." — Frank Hubbell, DO, Founder of Stonehearth Open Learning Opportunities (SOLO), Wilderness Medicine and Rescue Instructor, Conway, NH

"Students with a broad range of experience take wilderness medicine courses. It's not easy to find a comprehensive text that accommodates all their needs. Medicine for the Outdoors engages the non-professional while keeping the most seasoned provider informed in the latest techniques for backcountry medical practice. Dr. Auerbach has written another book that will become the gold standard for anyone with an interest in health and safety outdoors." — William Fred Baty, WEMT-P, Assistant Fire Chief, City of Knoxville Fire Department; Lead Wilderness Medicine Instructor, The Wilderness Medicine Program, Roane State Community College, Knoxville, TN

"This manual contains a wealth of succinct, up-to-date, and practical advice. It is an indispensable medical guide for wilderness enthusiasts and health professionals." — Kent R. Olson, MD, Medical Director, San Francisco Division, California Poison Control System

"Most first aid books describe a condition and sometimes advise simple first aid measures, but ultimately end up with the admonition to 'seek medical attention.' This is safe advice when a clinic or hospital or ambulance is right around the corner. But what about when you're on the adventure of a lifetime — in the wilds of Mongolia or the mountains of Tibet or several days out to sea? 'Seek medical advice' helps not a bit. In these situations, there is no better resource (including having a direct line to your hospital ER) than Medicine for the Outdoors. Dr. Paul Auerbach is to wilderness medicine what Bill Gates is to computers; he is the source, and so this book is a treasure trove of information not only for untrained laypeople but for most physicians. There is no more understandable or complete collection of information on what to do for anything that might befall an adventure traveler — from high altitude cerebral edema to soapfish dermatitis to cougar attack to how to stitch a laceration. Even better, Medicine for the Outdoors provides essential guidance in advance of an adventure to help with planning and prevention — from immunizations to equipment and clothing to dietary precautions. The handy appendices include a drug reference, conversion tables, and definitions of common medical terms. Contemplating an adventure? The old adage 'Seek medical attention' has been replaced with 'Get Medicine for the Outdoors.'" — Luanne Freer, MD, FACEP, FAWM, Founder/Director, Everest Base Camp Medical Clinic; Medical Director, Yellowstone National Park; Past President, Wilderness Medical Society

"You always hope for the best and plan for the worst. Being well prepared for the unexpected in the wilderness is greatly enhanced by our 'survival bible,' namely, Medicine for the Outdoors. Our guides, trip leaders, and clients never adventure without this well-written and easy-to-understand book, and we invariably benefit from it. The common sense approach and complete coverage have helped us mitigate situations and avoid greater emergencies. In all reaches of the globe, with Medicine for the Outdoors, we're much closer to definitive care." — Laurence Alvarez-Roos, Co-founder, Bio Bio Expeditions World Wide

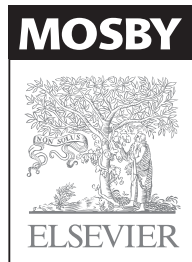
"This new update of Medicine for the Outdoors is more impressive and indispensable than ever. The uncomplicated, clear writing and illustrations are delightfully easy to understand, even though the book is remarkably thorough and superbly detailed. I highly recommend it to anyone who is serious about working and playing in the outdoors." — Donald C. Cooper, PhD, Editor, Fundamentals of Search and Rescue; Chair, National Fire Protection Association Technical Search and Rescue Committee

"This book provides invaluable guidance for both the medical teams that travel with us to remote areas around the world, and for the patients we treat there. Medicine for the Outdoors is a must-have medical manual for serious travelers who venture off the beaten path." — Rachel Friday, MPH, MA, RD, Director, Medical Expeditions International

"Auerbach's much enhanced fifth edition of Medicine for the Outdoors continues to serve as an ideal portable reference. Whether you are in the front country, exploring tropical reefs, or trekking at high altitude, Medicine for the Outdoors rapidly guides to solutions for the most important medical problems. I strongly recommend this reference as a primary source for laypersons as well as a supplement for individuals with advanced wilderness medicine training." — Brad L. Bennett, PhD, NREMT-P, FAWM, Captain, US Navy (Retired); Adjunct Faculty, Military and Emergency Medicine Department, Uniformed Services University of the Health Sciences

"Traveling in the wilderness or abroad can be punctuated by unexpected illness or injury. If you plan to travel where medical care is not readily available, Medicine for the Outdoors is the resource you want to have with you. Dr. Auerbach, one of the foremost experts on wilderness medicine, covers topics from basic first aid to major medical illnesses, trauma, medications, and medical kits. Medicine for the Outdoors provides knowledge that can help you survive until further assistance is available." — Albert R. Wheeler III, MD, Emergency Medicine of Jackson Hole, WY; Medical Director, Grand Teton National Park EMS

MEDICINE FOR THE OUTDOORS



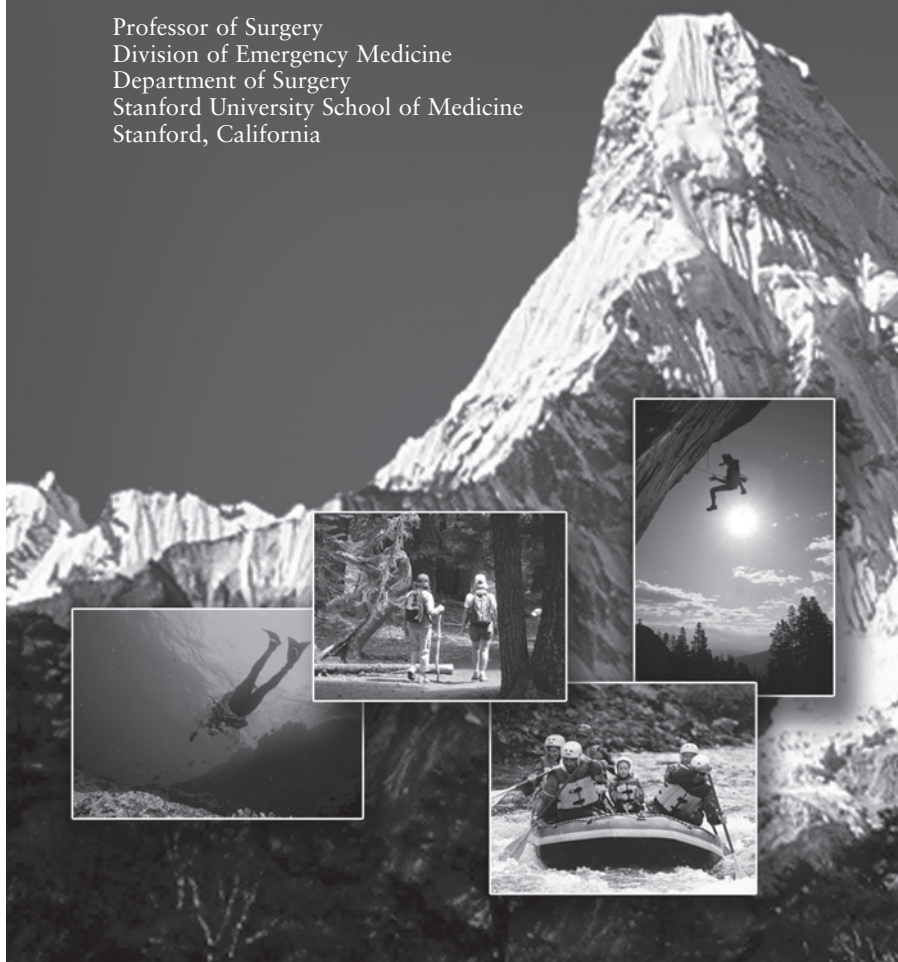
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FIRST AID AND MEDICAL EMERGENCIES
FIFTH EDITION

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PREFACE

The outdoor environment is beautiful, but it is ever changing and can become hostile in a moment. Good fortune favors the well prepared, and there are no more important considerations for a successful outdoor experience than safety and first aid. Severe weather, wild animals, rugged terrain, and equipment failure all conspire to create or complicate medical hardships that must be diagnosed swiftly and remedied with certainty. The therapies can be integral to survival. Medical education is thus as compelling as any other form of learning.

This revised fifth edition of *Medicine for the Outdoors* has been updated and rewritten based on advances in medical knowledge, suggestions from readers, and reviews of the previous edition. I am indebted to my family and friends, who continue to support me in my writing endeavors. Brian, Lauren, and Danny will soon be writing their own books. This book is dedicated to all of the people who have given generously of their time to the Wilderness Medical Society and thereby advanced the specialty of wilderness medicine.

With as much effort as we seek to maintain good health, let each of us seek to maintain the wilderness. It is my fervent hope that we can approach preservation of the planet Earth with the same passion that we have poured into the development of our vital medical missions; for without the wilderness, there can be no wilderness medicine.

Paul Auerbach, MD
Summer, 2009

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INTRODUCTION

The purpose of this book is to provide you with brief explanations of a wide variety of medical problems and to offer practical solutions. The book is arranged to make information easy to retrieve. Part One outlines basic principles of health care that should be applied to all outdoor travel. Parts Two and Three describe medical situations, beginning with life threats and covering, in turn, major and minor medical problems you might encounter. Part Four discusses disorders related to various wilderness settings. Part Five covers additional practical information, such as evacuation guidelines and techniques, water disinfection, useful knots and hitches, drug injection techniques, and recommendations for immunization. Appendix One lists medications and doses, with an emphasis on medications mentioned elsewhere in the book. Conversion tables for common measurements are found in Appendix Two. Appendix Three outlines guidelines for prevention of hepatitis, acquired immunodeficiency syndrome (AIDS), and other diseases transmitted by human body fluids. The glossary defines medical and technical terms. The index will guide you swiftly to any topic.

To keep the book to a manageable size, I assume that you have a basic understanding of how your body and organs are supposed to work. Thus, explanations are brief and to the point. This is neither a survival manual nor a sports medicine encyclopedia. Rather, the book is meant to be carried on a journey as a ready reference for a layperson who needs to medically rescue or aid an ill or injured victim. I have included information that is necessary to make simple, accurate diagnoses and to act on them.

This book does not transform a layperson into a physician, but unfortunately, there are times when medical help is miles or even days away. No intervention is completely without risk; however, some familiarity with diseases and injuries can minimize that risk. Although some of the techniques and drugs described could worsen a situation if misapplied or incorrectly administered, the treatments presented are current and well accepted. Still, *the recommendations should not be considered substitutes for prompt evaluation by a trained medical professional*. If at any time a diagnosis is uncertain, or a victim appears to be more than minimally ill, all efforts should be directed at seeking a professional medical opinion.

The basic therapies recommended are not those that could be rendered by a physician with sophisticated equipment and a large armamentarium of drugs. I have not described every infectious or tropical disease that could possibly be contracted during a journey abroad. However, the diagnosis and management of illnesses such as schistosomiasis, malaria, Lyme disease, anaplasmosis, yellow fever, dengue fever, West Nile viral disease, and Rocky Mountain spotted fever are relevant to many people who travel domestically and overseas in wilderness

areas, and have therefore been included. Because we live in an age of biohazards, information has been added to include a few of these entities, such as anthrax.

In addition to “Western medicine,” there is “complementary and alternative (from the Western perspective)” medicine, sometimes referred to as “naturopathic” medicine. While many of the recommendations of naturopathic doctors are appropriate and effective, I personally do not have the expertise on which to make such recommendations. However, in a wilderness setting, and certainly when being treated by healers in non-Western countries, you may wish to be the beneficiary of such remedies. If so, you will need to perform your own validation of remedies, such as *Melaleuca alternifolia* (tee tree) oil as a topic antiseptic or anti-itch preparation.

To use this or any medical reference to best advantage, review the pertinent sections before your expedition. Practice the manual skills, such as the application of splints and slings, until you are confident.

I have also provided information that is as important as medical knowledge. This includes such topics as how to avoid being struck by lightning, drowning prevention, and what to do if caught in a flood zone or near a forest fire.

I hope that you are enlightened, and that good luck prevails.

THE OUTDOOR ADVENTURER’S PLEDGE

1. I will maintain optimal physical and mental health.
2. I will prepare for all outdoor activities by dressing properly, anticipating likely risks, and carrying proper equipment for first aid.
3. I will break in new boots and shoes before I use them for hiking or climbing.
4. I will carry protective clothing to be used in bad weather.
5. If appropriate, I will be prepared for an unexpected night outdoors.
6. I will seek advice or assistance if I become ill or injured.
7. I will let someone know where I am going and when I expect to return.
8. I will not drink alcohol or use recreational drugs.
9. I will not participate in or tolerate risky horseplay in potentially dangerous situations.
10. I will use proper safety equipment, such as a helmet or life jacket, whenever possible.
11. I will obey all posted warning signs.
12. I will wash and disinfect my hands before eating.
13. I will drink lots of fluids and stay well hydrated. I will disinfect my drinking water and properly prepare all food.
14. I will not closely approach or otherwise provoke wild animals.



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PART ONE

General Information

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HOW TO USE THIS BOOK

To use this book to best advantage, read the appropriate sections *before* you embark on a trip. In this way, you'll remember where to find information in case of an emergency. Use the index to locate specific topics, such as bee stings, frostbite, or choking. When reading about different problems, you may be referred to general instructions for medical aid, which are presented in Parts One and Two. All readers are encouraged to participate in organized first-aid and outdoor safety programs, such as those offered by the National Ski Patrol, American Red Cross, Outward Bound, National Outdoor Leadership School, Stonehearth Open Learning Opportunities, Advanced Wilderness Life Support, Wilderness Advanced Life Support, and OutdoorSafe. Cardiopulmonary resuscitation (CPR) training that conforms to American Heart Association standards is available through multiple venues.

Many drugs recommended in the book are available only through prescriptions provided by physicians, who should explain each drug's use and side effects. All pregnant women should consult a physician before any expedition for current advice on the advisability of activities, immunizations, and the use of particular drugs. Many of the drugs mentioned in the book are listed in Appendix One.

For estimation of body weight, 1 kilogram (kg) equals 2.2 pounds (lb), so each pound equals 0.45 kilogram. For temperature conversion (when reading thermometers) between Fahrenheit and Centigrade (Celsius), use the following formula:

$$\text{DEGREES FAHRENHEIT} = (9/5 \text{ times degrees Centigrade}) \text{ plus } 32$$

or

$$\text{DEGREES CENTIGRADE} = 5/9 \text{ times (degrees Fahrenheit minus } 32)$$

A temperature conversion table is found on page 509. Volume and weight conversion tables are found on pages 512 and 513. For most practical purposes, 1 liter of liquid can be used interchangeably with 1 quart. I have also provided metric equivalents (sometimes rough) for most of the measurements given.

Although most people do not have ready access to oxygen tanks and masks, I have sometimes recommended oxygen administration for the benefit of those who are so equipped. Information about oxygen administration is found on page 431.

When administering an injection, *never* share needles between people. Appendix Three briefly discusses guidelines for prevention of hepatitis, acquired immunodeficiency syndrome (AIDS), and other diseases transmitted via contact with human blood and other body fluids.



BEFORE YOU GO

BE IN GOOD HEALTH

To the extent possible, be in good health. You can take a number of steps to accomplish this:

1. Maintain the proper weight for your height, age, and body type.
2. Exercise regularly. Be aware of your body's condition. Build strength, flexibility, and endurance.
3. Eat a healthy diet and learn to love fruits, vegetables, and complex carbohydrates. Take a vitamin supplement and pay particular attention to ingesting sufficient amounts of calcium, iron, and other nutrients essential to metabolism, growth, and preservation of your eyesight, bones, and joints.
4. Complete proper screening examinations for treatable diseases such as breast, cervical, colon, testicular, and prostate cancer. Think about your heart and brain, and test at appropriate intervals for high-density lipoproteins, low-density lipoproteins, and total cholesterol. Maintain your blood pressure below a worrisome value.
5. If you are pregnant, do not take chances with your baby's health.
6. Maintain all recommended immunizations against such diseases as tetanus and pertussis (whooping cough), and get a flu shot.
7. Wear your seat belt when driving; wear a helmet when riding a bicycle or motorcycle; and never attempt dangerous maneuvers if you are tired or intoxicated.
8. Give up tobacco.
9. Brush and floss your teeth at least once a day.

BE PREPARED

There is no substitute for preparedness. Adherence to this basic rule will prevent or ease the majority of mishaps that occur in the wild. Proper education before situations of risk allows you to cope in a purposeful fashion, rather than in a state of fear and panic. At least two, and preferably all, members of a wilderness expedition should understand first aid and medical rescue. On a casual family outing, at least one responsible adult should be skilled in first aid. Manual skills, such as mouth-to-mouth breathing, cardiopulmonary resuscitation (CPR), and the application of bandages and splints, should be practiced beforehand. Become familiar with technical rescue techniques pertinent to the environment you will be in (for example, high-angle rock, swift water, or avalanche-prone areas).

Be certain to carry appropriate survival equipment, such as maps, a global positioning system (GPS) or compass, waterproof matches, a knife, nonperishable food, a flashlight, AvaLung in avalanche territory, and adequate first-aid supplies. Minimize the need for improvisation.

Be prepared for the most harsh environmental conditions you might expect to encounter. To the best extent possible, become familiar with the setting and possible survival scenarios, particularly should you become stranded or lost. If you will be traveling in avalanche country, consider taking a level 1 avalanche certification course recognized by the American Avalanche Association or other reputable organization.

Before undertaking a trip where you will be far from formal medical assistance, it is wise to attend to any obvious medical problems. If you have not done so within the past 6 months, visit a dentist. Make certain that all of your immunizations are up to date (see page 449). If you have a significant medical problem, you should carry an information card, a MedicAlert bracelet or tag, or something similar.

A common question asked of wilderness medicine physicians is whether a person can engage in certain activities or travel in a particular environment, depending on the person's state of health and medical history. Given the number of persons with preexisting conditions, especially those who are part of a growing senior population, these are very important considerations. Whether a person has coronary artery disease, diabetes, rheumatoid arthritis, sickle cell anemia, or any other of numerous conditions, it is important to understand what situations are felt to be safe and what situations are felt to be risky. Preexisting conditions are sometimes classified as "unstable." If they are unstable, they can be worsening. In general, persons with unstable conditions should not travel to high altitude, because resultant low blood oxygen levels may impair or prevent recovery from the condition. If you have a preexisting condition, consult with your physician before undertaking any activity, such as that in extreme cold, heat, or altitude, or travel remote from medical care, that might put you or your companions at (unacceptable) risk.

A sexually active woman of childbearing age should have a test for early pregnancy detection before a wilderness expedition. Any pregnancy under 8 weeks' gestation has a 25% chance of miscarriage. Furthermore, it might be sensible to confirm (usually by an ultrasound examination) that the fetus is properly situated within the uterus, and that there is not a risk for an ectopic (outside-the-uterus) pregnancy (see page 133), which could rupture and threaten the mother's life.

COMMON SENSE

Many accidents occur because people ignore warning signs or don't anticipate problems. Swimmers are stung by jellyfish outside protective net enclosures; non-swimmers drown while participating in hazardous whitewater rafting adventures.

Pay heed to rangers, posted warnings, weather reports, and the experience of seasoned guides. Prepare for situations of risk by developing your skills in less challenging conditions. Wear recommended personal safety equipment, such as a flotation jacket, safety harness, or climbing helmet. Do not tolerate horseplay in dangerous settings.

When abroad, remember that most injuries occur while traveling on roadways, so be particularly careful. Although it may be tempting to participate in the local modes of transportation and ignore common safety rules, it is hazardous. Do not ride in the back of a truck or on the roof of a bus, always wear a seatbelt, wear a helmet when on a motorcycle or moped (if you must use these conveyances), avoid nighttime travel, and do not travel alone. If there are traffic rules, they are often not enforced. Look both ways, twice, before crossing a road or path.

CONDITIONING AND ACCLIMATIZATION

Many health hazards of wilderness travel, such as falls, can be avoided by a reasonable degree of strength and endurance, which can only be acquired by conditioning. Every expedition member should begin from a state of maximum fitness. Other health hazards, such as temperature extremes and high-altitude disorders, can in certain circumstances be avoided by acclimatization to the environment. Acclimatization is a physiological adaptation that is often different from, and may be unrelated to, physical fitness.

EQUIPMENT

Be prepared for foul-weather conditions. Always assume that you will be forced to spend an unexpected night outdoors. Carry warm clothing and waterproof rain gear. Break in all footwear, and take care to pad rough edges and exposed seams. Consider carrying a compact emergency position-indicating radio beacon (EPIRB).

All expedition leaders should carry safety and first-aid supplies for the most likely mishaps. Medical supplies must be arranged so that they can be rapidly located and deployed. Recommended first-aid items are listed in Part Five.

COMMUNICATION

Prepare a trip plan (itinerary) and record it in a location (trailhead, ranger station, marina, or the like) where someone will recognize when a person or party is overdue and potentially lost or in trouble. Similarly, determine beforehand a plan for getting help in an emergency, whether it involves radio communication, ground-to-air or ship-to-shore signals, cellular telephone, or knowing

the location of the nearest pay telephone, ranger station, or first-aid facility. If mobile rescue-grade equipment is to be used, it should be checked and double-checked before departure, and regularly scheduled communications should be prepared. At least two members of any expedition should be able to fashion standard ground-to-air distress markers. Make sure that children wear an item of bright clothing and carry a whistle that they know to blow if they are frightened or lost. If you carry a radio, know how to tune in to a weather information channel. The National Weather Service issues a “watch” when conditions are right for the development of a particular weather pattern, and a “warning” when its arrival is imminent.

If you will be traveling within an area with telephone or radio communication, whether at land or sea, carry precise instructions for persons to be able to communicate in an emergency. For instance, a diver should know how to contact the Divers Alert Network (www.diversalertnetwork.org) hotline. An expedition may wish to establish a relationship with an organization such as Global Rescue (www.globalrescue.com) for medical consultation or evacuation.

TRIP PLANS

In most stories of miraculous ocean or wildland survival, the first chapter includes the account of how the victim lost his way. All wilderness travelers should carry maps, be proficient with GPS or compass routing, understand how to signal for help, and know in advance where they intend to explore. People with specific medical disabilities, such as chronic severe lung disease, may be advised by a physician to avoid certain stressful environments, such as high altitude. If you are traveling in snow country, you should know how to avoid being caught in an avalanche, and consider carrying an avalanche rescue beacon (transceiver) that operates on the frequency of 457 kilohertz (kHz). The signal carries 100 to 150 ft (30 to 46 m) and is received by the rescuers’ units. In avalanche country, also carry a shovel and a collapsible probe pole. Consider wearing an AvaLung or an ABS Avalanche Airbag System. A new technology for locating an avalanche victim is the RECCO harmonic radar-based detector.

MEDICINES

There is no need to carry a drugstore on a day hike. On the other hand, drugs necessary to treat established medical problems (such as nitroglycerin tablets or spray for a person with angina) should always be on hand. It is the responsibility of the trip leader to be aware of any potential medical problems and to insist that people in obviously poor physical condition not undertake activities that might endanger themselves or others. Any person with allergies, diabetes, epilepsy, or

special medical instructions should wear an identification bracelet or carry a medical information card. Anyone who takes medications should carry a list of drugs and doses. If you travel abroad, it is wise to carry an adequate supply of routine medications, as well as a note from a physician stating their necessity, should you be questioned or need refills. All people should receive adequate antitetanus and other locally required immunizations before the trip. Basic medical supplies are listed in Part Five.

NUTRITION

Anyone who undertakes vigorous physical activity should consume adequate calories in a well-balanced diet. A debilitating weight-reduction program should not be continued in the wilderness, where a rescue might depend on extraordinary effort and endurance.

To avoid dehydration and exhaustion, take adequate time to eat, drink, and rest. Most adult men require 3,000 to 5,000 food calories each day to sustain heavy physical exertion. Women require 2,000 to 3,500 calories. A nutritious diet can easily be maintained with proper planning. Don't plan to live off the land unless you are a survival expert.

Consider carrying a supply of energy bars, such as the Clif Bar, Luna Bar, Lärabar, Balance Bar, Promax Bar, or PowerBar. For a less nutritive energy boost of carbohydrates, sodium, and potassium, carry Clif Shot Energy Gel or Gu Energy Gel.

FLUID REQUIREMENTS

Fluid requirements have been well worked out for all levels of exercise. They are highlighted again in the section on heat illness (see page 322). Most people underestimate their fluid requirements. Although there is variation, the following is a hydration requirement based on an average minimal recommendation of 2 to 3 liters of liquid per day for an adult man: minimal water loss—2,300 mL; water loss in hot environmental temperature—3,300 mL; and water loss during heavy exercise with significant sweating—6,600 mL. Other factors that increase fluid loss are activities at high altitude or in cold, dry air (increased loss during breathing), anything that increases sweating, and ingestion of drugs (e.g., alcohol or diuretics) that increase urinary losses.

Encourage frequent rest stops and water breaks. If natural sources of drinkable water (springs, wells, ice-melt runoff) will not be encountered, you should carry at least a 48-hour supply. Carry supplies for water disinfection (see page 433). Inspect your urine to be certain that it is light colored, rather than dark colored. Dark coloration usually indicates that you are not adequately hydrated.

DISASTER PREPAREDNESS


If there is a chance that you may be called on to assist during a disaster, it is important to be prepared. At a minimum, you should be prepared to be self-sufficient:

1. Be physically and emotionally fit.
2. Be vaccinated for any diseases endemic to the region in which you will be a rescuer.
3. Carry a kit that will allow you to survive for a few days. This kit should contain at least the following items:
 - A. Water disinfection supplies sufficient to generate 2 liters of water per day. It is better to be able to prepare 4 liters of water per day.
 - B. Food that requires little or no preparation.
 - C. An improvised shelter, such as a plastic sheet, cord, garbage bags, “space” blanket, and sleeping bag.
 - D. Fire preparation supplies (e.g., tinder and firestarter).
 - E. Maps, a compass, and a GPS unit.
 - F. Emergency lighting, including a headlamp and extra batteries.
 - G. Cell phone or satellite phone. Also carry a whistle, survey tape, a mirror, and pad and pencil.
 - H. First-aid kit.
 - I. Insect repellent and sunscreen.
 - J. Extra prescription glasses, extra clothing, and a multi-tool with a sharp knife.

“SIZING UP” THE SCENE

When you come across a victim in need of help, he or she often is part of an accident scene, and so you must “size up” the scene. A structured approach will help keep you and everyone else calm, and it will maximize the chances for a successful outcome.

1. Don’t rush in until you have had an opportunity to look over everything—the physical setting, any obvious hazards, and the victim(s).
2. Don’t assume that you appreciate how sick or injured the victims are until you have had a chance to examine them or take a report from a reliable examiner.
3. Examine the victim(s).
4. Make an initial call for help as soon as you are able, and try to include as much information about your location, the conditions of the victims, and what you need (supplies, food, etc.) as possible.
5. Begin treatment and explain to the victims what you are doing.
6. Think about shelter and assign someone to that task.
7. Eliminate any physical dangers to the victims and rescuers.



GENERAL FIRST-AID PRINCIPLES

In all first-aid situations, the rescuer must remain calm. If you panic, you will lose control of the victim, as well as of yourself. To establish authority, speak and act calmly and purposefully. Allow the victim to discuss the incident, his situation, and his fears. If you can involve the victim in his rescue and treatment, it is often good for his morale. Try not to be judgmental, and save criticism for after the event. Avoid laying any blame on people; they may get hurt emotionally or become argumentative as a result. When communicating with a victim and bystanders, remember that you are not only caring for the victim, but in many ways, for family and friends. It is important to communicate frequently, honestly, and in a manner that is reassuring and inspires cooperation and hope.

Do not endanger additional inexperienced rescuers. If you cannot get to the victim easily, send for help. Approach all victims safely; don't allow the sense of urgency to transform a sensible rescue into a series of risky, or even foolhardy, maneuvers. If it appears that the victim is too ill to be moved, set up camp immediately. In all cases, protect the victim from the elements from above and below.

If you have paper and a writing instrument, record your observations. If you send someone for help, have him carry a piece of paper that states the victim or victims' location, the nature of the emergency, the number of people needing help, the condition of the victim(s), what is being done to treat the victim(s), and any specific environmental conditions or physical obstacles. Accident report forms are available from organizations such as The Mountaineers.

Always assume the worst. Assume that each victim you encounter has a broken neck or has had a heart attack until proven otherwise. Always be conservative in your treatments and recommendations for further evaluation or rescue.

Never move a seriously injured victim unless he is in danger from the environment or needs to be moved for medical reasons. Don't encourage a victim to get up and "shake it off" until you have examined him for a potentially serious problem.

If you must remain in a wilderness location for a prolonged period of time caring for a victim, remember to attend to the basic survival requirements, which include air (oxygen) for breathing, shelter, water, food, psychological support, and human waste disposal.

Never administer medicines or perform procedures if you are not sure what you are doing. The good Samaritan has certain legal protections for his actions so long as he operates within prudent limits and takes reasonable care. This book will not make you a doctor. A good rule to follow is *primum non nocere*: "First of all, do no harm." If you are not certain what to do and the situation

isn't worsening, don't interfere. Explain to the victim that you are not a physician, but will do your best to get him through whatever crisis he has encountered, to the best of your knowledge and ability. If you encounter a victim who may be seriously ill, seek an expert opinion as soon as possible. Even if your treatment seems successful, it is wise to consult a physician if you would have ordinarily done so.

Listen to the patient. The story of what happened and the medical history can be extremely important in making swift and appropriate medical decisions. Let the victim tell you what happened in his or her own words, and try not to interrupt unless it is important. If a victim has a sprained ankle, a comprehensive discussion may not be necessary, but if it is appropriate, try to elicit the following:

Current illness: What happened? When did it happen? Why did it happen? If the victim is suffering pain, describe its location, time of onset, whether it came on suddenly or gradually, whether it comes and goes, its quality (dull, sharp, cramping, etc.), how it is made worse or relieved, and whether the victim has suffered anything similar before (and if so, whether there was a medical diagnosis). Have the victim describe all symptoms, such as nausea, vomiting, diarrhea, blurred vision, shortness of breath, fatigue, cough, and so on.

Prior illnesses and preexisting conditions: Have the victim describe any previous illness (heart attack, asthma, pneumonia, meningitis, etc.) and any current conditions (diabetes, anemia, abnormal heart rhythms, etc.) and how they have been and are currently being treated.

Surgeries: Have the victim list any surgical operations, such as appendectomy or knee surgery.

Allergies: This includes allergies to food, plants, insects, and medication(s) and the nature of the allergic reaction(s).

Immunizations, exposure to communicable diseases, foreign travel, recent dietary history: Any of these may be appropriate if the victim is perhaps suffering from an infectious disease, including food poisoning or toxic ingestion.

Review of systems: This is a comprehensive questioning about each organ system to determine if the victim has or has ever had symptoms referable to each system:

Head: headache, dizziness

Eyes: blurred vision, double vision, decreased vision, discharge, pain

Ears: decreased hearing, ringing in the ears, discharge from the ears, pain

Nose: nosebleeds, difficulty breathing, nasal discharge, sinus infection

Throat: sore throat, foreign body sensation, tonsillitis, hoarseness
or difficulty talking, painful swallowing, difficulty swallowing

Dental: tooth loss, abscess, dentures

Neck: pain, decreased range of motion, arthritis

General: fever, chills, weakness, unintentional weight loss or gain,
dizziness, history of intravenous drug use

Chest (lungs): difficulty breathing, shortness of breath, wheezing, cough (productive of sputum or nonproductive), coughing blood, history of tobacco use

Heart: palpitations, pressure-like sensation in the chest, chest pain

Abdomen: pain, mass

Gastrointestinal: nausea, vomiting (describe what is vomited), diarrhea (describe consistency), red blood in stools or dark black stools, yellow skin (jaundice), perianal itching, constipation, excessive gas, bloating, belching

Hematologic/immune: anemia, frequent infections, exposure to human immunodeficiency virus (HIV)

Genitourinary: change in frequency of voiding, painful urination, discolored or malodorous urine, back pain, blood in urine, history of sexual contacts, penile or vaginal discharge, date and character of last menstrual period (normal, abnormal), vaginal bleeding

Neurologic: seizure, weakness in any body part, numbness or tingling of any body part, difficulty with coordination or walking, difficulty with speech or comprehension, fainting

Muscular: muscle cramps, weakness, incoordination, pain

Psychiatric: abnormal thinking, hallucinations (visual or auditory), desire to hurt self or others, inappropriate crying or laughing, depression

SECURE THE SCENE

Be certain that you, the victim, and other rescuers are protected from inclement weather, lightning, rockfall, avalanche hazard, and so on. Create a shelter or assign someone to this task as soon as you can. Retreat from a venomous snake, a swarm of stinging insects, the edge of a swiftly flowing frigid river, or the like.

EVALUATE THE VICTIM

Immediately determine if the victim is breathing, if his heart is beating, and if he has any obvious major injuries. Techniques and procedures for treatment are covered in Part Two.

Look, listen, and feel for breathing (Figure 1). Put your ear close to the victim's mouth and nose, and try to detect if he is moving air into and out of his lungs. Watch for chest wall motion. Determine if a victim is breathing by listening and feeling for air movement around the mouth and nose and observing the chest for unassisted rise and fall. In cold weather, look for a vapor cloud or feel for warm air moving across your hand. If the victim is not breathing well (or at all), you must manage the airway (see page 22) and begin to breathe for him (see page 28), *taking care to maintain the position of*



Figure 1. Look, listen, and feel for air movement.

the neck if there is any chance of a cervical spine injury (see page 37). Observe the number of breaths per minute; normal is 12 to 18 per minute for adults, 18 to 25 per minute for small children, and 25 to 50 per minute for infants.

Characterize the nature and effort of breathing. Look to see if breathing is effective—the chest expands and air movement is appreciated. Observe if the victim is laboring to breathe. In an adult, if the breathing rate is less than 10 or greater than 30 breaths per minute, the skin color is blue, or the victim is confused or unconscious, be prepared to assist breathing (see page 28). If the breathing is noisy, rattling, or “musical” and high-pitched, suspect an airway obstruction (see page 23), particularly if the victim is lying on his back. If the victim has a loose denture or another dental appliance, remove it. If there is no chance of a cervical spine injury (see page 37) and it appears that the victim may vomit, position him on his side. If you are concerned about a neck injury, use the logrolling maneuver (see page 39).

Near the condition of death, a person may show “agonal respirations,” characterized by infrequent mouth openings without any chest rise, sometimes accompanied by head lifting.

Feel for a pulse. Current American Heart Association guidelines advise laypersons to begin chest compressions without going through a pulse check on victims who are not breathing and who do not show any sign of life. Basic life support may also be initiated by checking for a pulse. Place the tips of your index and

middle fingers (not your thumb, which can generate a “false” pulse—your own!) gently on the radial artery in the wrist (see Figure 16, C, page 33). If you cannot detect a pulse there (particularly if your fingers are cold), move your fingers quickly to the brachial artery (this is particularly useful for infants) at the midpoint of the inside of the upper arm (see Figure 16, E, page 33), the femoral artery in the groin (see Figure 16, B, page 33), or the carotid artery in the neck (see Figure 16, A, page 33). If no pulse is detected in any of these locations (and the victim is not breathing or verbalizing), begin chest compressions (see page 32). Observe the pulse rate; normal is 55 to 90 per minute for adults, 80 to 110 per minute for small children, and 100 to 130 per minute for infants. The pulse rate is faster with excitement or fear and slower in trained athletes. A rapid and weak (“thready”) pulse is a sign of impending shock (see page 60), usually due to excessive bleeding, dehydration, or heart problems. An irregular pulse may indicate an abnormal heart rhythm.

Locate brisk bleeding. Quickly survey the victim to locate any obvious sources of brisk bleeding. Quickly apply firm pressure to these areas (see page 54).

Once you have dealt with these life-threatening problems, begin a careful, complete examination of the victim.

If an injury may be extensive, examine the whole victim. Particularly dangerous situations include falls; blows to the head, neck, chest, or abdomen; altered mental status; difficulty breathing or shortness of breath; and injuries to children. In these cases, or whenever the diagnosis is not readily apparent, evaluate the victim from head to toe. Weather and appropriate modesty permitting, be sure to undress the victim sufficiently to perform a proper examination. Look around the neck or on the wrist(s) for a medical alert (such as MedicAlert) tag, and in a wallet, helmet, or pack for an information card.

Because most bodies are bilaterally symmetrical, if you are having difficulty determining if a body part is abnormal or deformed, compare it to the opposite side. Always ask a victim to move a body part before you do it for him; if he resists because of pain or weakness, you need to suspect a broken bone or spinal cord (nerve) injury. Do not “force” a motion.

Take as much time as you can afford to explain to a victim what you are going to do. This is usually reassuring. If the victim is a child, it is important to make eye contact, and to be continually supportive. If someone is doing or has done something with which you don’t agree, make any argument or criticism out of earshot of the victim. If the examiner is opposite in gender to the victim, try to have a same-gender witness (chaperone). When examining a victim, keep talking to him. Closely observe for indications of discomfort or pain.

1. Check the victim’s mental status. If he is awake, determine if he is oriented to time, place, and person. (“What is the date? Where are you? Who are you?”) If the answers are in any way abnormal, suspect a head

injury, intoxication, stroke, central nervous system infection (such as meningitis), hyperthermia, hypothermia, severe altitude illness, low blood sugar, or hypoxia (insufficient oxygen to the brain). Maintain constant observation of the victim until all of his responses are appropriate.

2. Examine the neck. Without turning the victim's head, feel each cervical vertebra from behind and note tenderness or muscle spasm. The seventh vertebra will be the most prominent. Check for swelling. Feel the Adam's apple in the front of the neck for tenderness or a "crunching" sensation (noted by both the examiner and victim). If there is a chance of neck injury, immobilize the neck (see page 37).
3. Examine the spinal column. Run your fingers down the length of the spine to elicit any tenderness. Check for spinal cord injury by having the victim voluntarily move his arms and legs and report his sense of feeling. Ask the victim to squeeze your hand with each of his, and then to "press down on the gas pedal" with each foot against your hand. Pinch the skin on the back of the hand and top of the foot as a crude measure of sensation. If any response (hand-to-hand or foot-to-foot) is asymmetrical, suspect a spinal cord injury or stroke (see pages 37 and 144).
4. Examine the head—but try not to move it. Feel the entire scalp for raised areas or cuts. Look into the ears for drainage (clear [spinal] fluid, blood, or pus). If there is blood, capture some on a white absorbent cloth or gauze pad. If the blood forms a ring, with a faded or yellow area toward the center, this may indicate the presence of spinal fluid. Feel the nose for obvious malalignment or instability. Look up into the nostrils. If you have a flashlight, shine it into the eyes to see if the pupils constrict and are equal in size. If you don't have a flashlight, cover the eyes and then uncover them to see if the pupils constrict. Pinpoint (constricted) pupils may be a sign of brain injury or drug overdose. Unequal pupils may represent a direct injury to an eye or a brain injury. Nonreactive and bilaterally dilated pupils may represent a severe brain injury. Ask the victim to follow your fingers with his eyes; if this cannot be done, if the eyes do not move together, or if he reports blurred or double vision, there may be a problem. If the eyes are spontaneously jerking or wandering, this may also indicate abnormality. If the victim has contact lenses, he may require assistance with their removal (see page 183).

Have the victim open and close his mouth to see if the teeth fit properly. Check the teeth for absence, looseness, or breaks, and the tongue for cuts. Ask the victim if he can swallow. Ask him to say "Ah" and see if you can get a glimpse of the back of his throat. Smell for any unusual odor on his breath. If dentures are loose, remove them. Smell the victim's breath to detect any abnormal odor (e.g., alcohol or "fruity" breath associated with severe diabetes).

5. Examine the skin. Look for sweating, skin color (normal may—and pale does—indicate inadequate circulation; dusky blue indicates hypothermia or shock; reddened indicates heat illness or sunburn; yellow indicates liver disease; mottled indicates low blood pressure, shock, or massive infection), bruises, rashes, burns, bites, and cuts. Note the skin temperature. Look inside the lower eyelids for a pale color that might indicate anemia or internal bleeding. If you pinch the skin on a victim's forearm and it remains "tented" and loose, the victim may be dehydrated.
6. Examine the chest. Observe whether the chest expands fully and equally on both sides with breathing. Feel the chest wall for tenderness and inspect for deformation or embedded objects. Place your ear against each side of the chest to listen for breath sounds.
7. Examine the back and abdomen. Gently press in all areas to elicit tenderness. Examine the buttocks and genitals.
8. Examine all bones. Gently press on the chest, pelvis, arms, and legs to elicit any tenderness. Run your fingers down the length of the clavicles (collarbones) and press centrally where they join the sternum. Trace each rib with your fingers. Look for deformation or discoloration.
9. Take a temperature. Use a digital, mercury, or alcohol thermometer, if possible one that can detect hypothermia or hyperthermia, depending on the circumstance. Rectal temperature measurement is more reliable than oral or axillary (see page 167) measurement, but may be impractical in the field. Always shake down a mercury or oral thermometer, and hold it in place for at least 3 minutes to obtain a reading. Do not rely on skin temperature to accurately reflect changes in the core temperature.

Send for help early. As soon as you have determined that a situation will require extrication, rescue, or advanced life support, initiate your prearranged plan for communication and transportation. Don't assume that someone will call for help; you must assign this task to a specific individual.

If you are in a situation where you can access the emergency medical service (EMS) system (911 or other telephone number), be prepared to provide the following information: the victim's location, your phone number, the nature of the emergency, the number of people needing help, the condition of the victim(s), what is being done to treat the victim(s), and any specific environmental conditions or physical obstacles. Speak slowly and clearly, and don't hang up until the dispatcher tells you he has all the information he needs.

While you are waiting for help to arrive:

1. Take an adequate history. Listen carefully to the victim; in most cases, he will lead you to the affected organ system. Inquire about allergies (especially to medications), previous surgeries (for instance, if he has had his appendix out, he can't get appendicitis), previous illnesses, medications, and the current event.

2. Reassure the victim. Most disorders are not life-threatening and will allow you plenty of time to formulate a treatment plan. Be sure to introduce yourself to the victim, and explain what you are doing in a direct fashion. Avoid making comments such as “Oh my God,” “This is a hopeless situation,” or “Whoops!” Let the victim know that you are capable and in charge. Accentuate the positive aspects of the situation, to build a climate of hope. Do not argue with other rescuers in the presence of the victim. Be particularly gentle, parental, and reassuring with children. Always warn the victim before you do anything that might cause him pain.
3. Keep the victim comfortable and warm. Do not feed a victim who cannot purposefully swallow. If he can eat and drink, offer water, clear soups, and clear juices. Use Oral Rehydration Salts (see page 208) or an electrolyte-containing sports beverage to maintain hydration. Avoid coffee, tea, and other caffeinated beverages.
4. Keep a written record of all medications given. If possible, also record symptoms and objective measurements (such as temperature) with times noted.
5. Remove all constrictive clothing or jewelry from any injured areas. If the victim has a hand wound, all watches and rings (see page 477) should be removed before swelling makes doing so impossible. In particular, rings left in place can become inadvertent tourniquets on swollen fingers.

Always reexamine and reevaluate a victim at regular intervals. A person may not experience difficulties until after a time delay, particularly if the problem is related to a head injury or internal bleeding. If you are concerned enough about a person to examine him once, wait a while and then examine him again. The interval between examinations is determined by your level of concern. For instance, someone with possible internal bleeding (see page 59) should be examined every 10 to 15 minutes until you are confident that the severity of the situation has declined sufficiently to warrant less vigilance. *If someone has an altered mental status (particularly after a head injury), he requires your constant attention.*

Try to maintain reasonable hygiene. This includes handwashing with soap and water, or using an alcohol-based hand gel. This is particularly important as an interval activity between multiple victims. Be aware that alcohol-based hand gel is not particularly effective against spore-forming bacteria, such as *Clostridium difficile*.



MEDICAL DECISION-MAKING

The art of outdoor medicine absolutely depends on observation, anticipation, and resourcefulness. The cardinal rule is to act conservatively and not take unnecessary risks when making the decision to continue a journey or to postpone travel and seek formal medical attention. Similarly, you may need to decide whether to carry out a disabled victim, or to stay put and signal or send for help.

Although every situation is unique, all decisions begin with an accurate assessment of the victim's condition. The situation should be categorized as trivial (small cuts, insect sting without allergic reaction, a single episode of diarrhea); minor (sprained ankle, small burn wound, sore throat); moderately disabling (broken wrist, kidney stone, bronchitis); potentially severe (chest pain, severe abdominal pain, high fever); totally disabling (seizure, broken hip, severe high-altitude illness); or life- and limb-threatening (uncontrolled bleeding, extensive frostbite, venomous snakebite with symptoms). In all cases that are other than trivial or minor, it is proper to insist on prompt evacuation or rescue for thorough evaluation. Never overestimate your abilities as a healer or count on good fortune. *The assumption under which you must operate is that a victim's clinical condition will deteriorate, particularly in a harsh environmental setting.* No adventure is worth a lost life or permanent disablement.

If more than one victim is injured, you must set priorities and attend to the most critically injured. Continually evaluate each victim to detect improvement or deterioration over time. Don't focus on situations that are beyond reasonable hope. For example, if a victim is near death from severe burns, decide if there is really anything you can do to save him, and if not, get busy with the people you can help. These are emotionally charged and extremely difficult decisions, even for those of us who have made them for many years.

You may have to decide whether to evacuate a victim or wait for a rescue party. In some instances, this is an easy decision—when a victim must be carried to a lower altitude to treat severe mountain sickness, for instance, or when the transport route is short and easily negotiated. The judgment call is based on weather conditions, the nature and severity of the injury or illness, and the distance that needs to be covered.

PART TWO

Major Medical Problems

This section describes common disorders that may be life-threatening. The problems are often present in combination and require prompt recognition and management.

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AN APPROACH TO THE UNCONSCIOUS VICTIM

Any disorder that decreases the supply of oxygen or sugar to the brain or that causes brain swelling, bleeding into the brain, or alteration of critical body chemistries can lead to unconsciousness. Thus, virtually every major illness or injury can ultimately render a person unconscious. If you come across someone who cannot be awakened, you must rapidly assess him for any treatable life-threatening conditions, and then try to discover the cause of the altered mental state.

The victim should not be moved until you carefully perform the following examination in sequence. Until you are absolutely certain that the victim does not have a neck injury, do not attempt to arouse him by vigorous shaking methods.

1. Evaluate the airway (see page 22).
2. Evaluate breathing (see page 28).
3. Check for pulses (see page 33).
4. Protect the cervical spine (see page 37).
5. Control obvious bleeding (see page 53).
6. Examine the victim for chest injury (see page 42), broken bones (see page 70), and burns (see page 108).
7. Consider shock (see page 60), head injury (see page 61), seizure (see page 68), severe allergic reaction (see page 66), low blood sugar (see page 142), stroke (see page 144), fainting spell (see page 165), hypothermia (see page 305), heat illness (see page 322), high-altitude cerebral edema (see page 340), high-altitude pulmonary edema (see page 339), lightning strike (see page 395), poisoning, and alcohol (drug) intoxication.
8. Remove contact lenses (see page 183).
9. Transport the victim to medical attention (see page 459).

HELMET REMOVAL

If the victim is wearing a helmet, it may be necessary to rapidly remove it to get to the airway. It is very important to do this in a way that protects the neck from twisting or bending forward or backward. It usually takes two persons to safely remove a helmet:

1. The first rescuer, positioned above the head of the victim, holds the helmeted head steady by grasping it on each side. If necessary to support the airway, the first rescuer can reach down and hold the mandible (lower jaw).
2. The second rescuer, positioned below the head of the victim, prepares the helmet for removal by loosening and removing straps, goggles, and other attachments, so long as this process does not allow for unintended head movement.

3. The second rescuer takes over head stabilization, while the first rescuer continues to hold the helmeted head, by sliding two hands along the sides of the victim's head position; this should be done by either placing one hand behind the base of the head at its junction with the neck and the other hand under the chin or by sliding two hands along the sides of the head and up inside the helmet.
4. The first rescuer completes removal of retaining straps, then slides the helmet off the head using axial (straight up away from the feet, without any twisting) traction.
5. Head positioning and gentle traction is maintained while a cervical collar or other method (see page 37) is used to stabilize the position of the head and neck.

AIRWAY

Airway obstruction is one of the leading causes of death in victims of head injury, and a frequent complication of vomiting in an unconscious person. Adequacy of the airway and breathing must be attained rapidly in every victim. In the absence of hypothermia, an interval of four minutes in which there is a failure to oxygenate the brain can lead to irreversible damage.

Figure 2 depicts the anatomy of the respiratory system. Air enters the mouth and nose (where it is humidified), traverses the pharynx (throat), passes through the

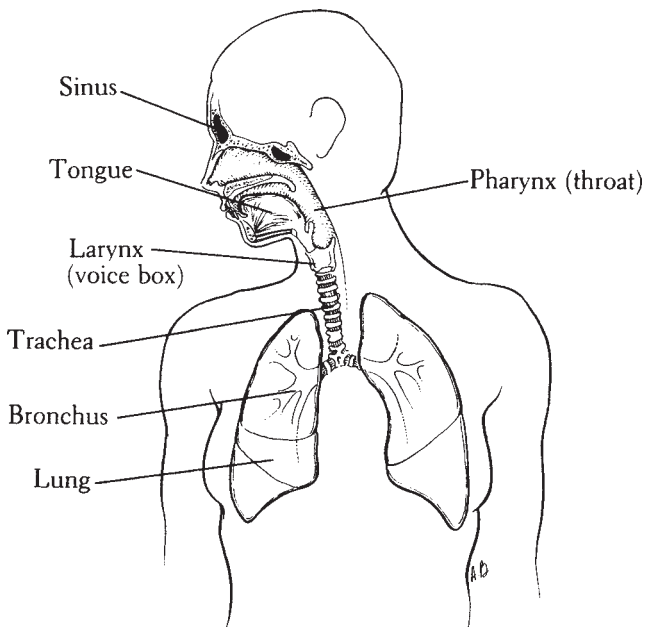


Figure 2. Anatomy of the respiratory system.

trachea (windpipe) and bronchi, and normally proceeds into the smallest air sacs of the lungs, known as the alveoli. Within these distal air spaces, inspired oxygen is exchanged for carbon dioxide, one of the end products of human metabolism. During swallowing, the epiglottis and tongue cover the entrance (via the vocal cords) to the trachea, so that food and liquid enter the esophagus and not the airway.

Obstruction of the airway at any level can interfere with the passage of air, delivery of oxygen via the lungs to the blood, and exhalation of carbon dioxide. The mouth and pharynx may fill with blood, vomitus, or secretions. With facial injury, deformation of the jaw or nose may hinder breathing. In a supine (faceup) unconscious victim, the tongue may fall back into the pharynx and occlude the opening to the trachea. Inhalation of food can obstruct the opening between the vocal cords and cause rapid suffocation.

Symptoms of airway obstruction include sudden inability to speak, an appearance of panic with bulging eyes, blue skin discoloration (cyanosis), choking gestures (hand held to the throat) (see Figure 11), harsh and raspy or “musical” and high-pitched noise (“stridor”) that comes from the throat during breathing, and difficulty with breathing as evidenced by struggling and profound agitation. Any person who collapses suddenly, particularly while eating, or who has been in an accident should be examined rapidly for airway obstruction.

1. *Under no circumstance should the neck be manipulated if there is a possibility of injury to the spine or spinal cord.* If a victim is unconscious and has suffered a fall or multiple injuries, it is safest to assume that his neck is broken. If this is the case, keep the airway open by gently but firmly lifting the jaw, either by grasping the lower teeth and jaw and pulling directly forward (away from the face), or by maintaining a forward pull on the angles of the jaw (Figure 3). Do not bend the neck forward or backward. A modified jaw thrust (Figure 4) can be performed by a single rescuer while stabilizing the neck.
2. *If there is no chance of a broken neck,* maintain the airway with the jaw lifts previously described or by tilting the head backward while gently lifting under the neck (Figure 5). The alignment is different for an infant, a small child, and an older child or adult in terms of where one would position a pad or pillow (Figure 6). A head tilt with chin lift may be used (Figure 7).
3. Keep the airway clear of blood, vomitus, loose dentures, and debris. This can be accomplished by sweeping the mouth with two fingers or by continuous suction with a field suction apparatus powerful enough to extract chunks. Take care not to force objects deeper into the throat. If the tongue appears to be the problem, wrap the end of the tongue in a cloth or gauze bandage, grasp firmly, and pull it out of the mouth (Figure 8). If it cannot be held in this manner, a large safety pin or sharp-pointed wire may be passed through the tongue and used to improve the grip (see Figure 8); take care to avoid the large, visible blood vessels at the base of the tongue. To keep the tongue out of the mouth, a string can be tied to the safety pin and then secured to the victim’s shirt button or jacket zipper. Fortunately, in most cases the jaw lift will carry the base of the tongue out

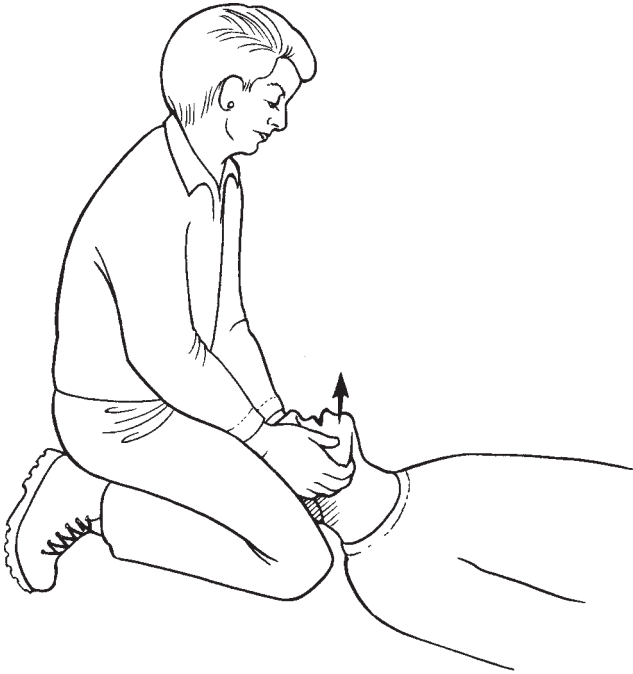


Figure 3. Jaw pull to open the airway.



Figure 4. Jaw thrust to open the airway. Grasping the angles of the lower jaw firmly, the rescuer pulls forward to lift the tongue out of the throat.

of the airway. Another technique is to use two safety pins to attach the tongue to the face just below the lower lip (Figure 9).

4. If the victim is unconscious, and there is no chance of a broken neck or back, do not leave him lying flat on his back. Turn him on his side so that if vomiting occurs, the fluid can drain from his mouth and the victim won't choke or drown (Figure 10).



Figure 5. Positioning the head to control the airway. The forehead is gently pushed back while support is maintained under the neck. *Never* manipulate the head or neck if a broken neck is suspected.

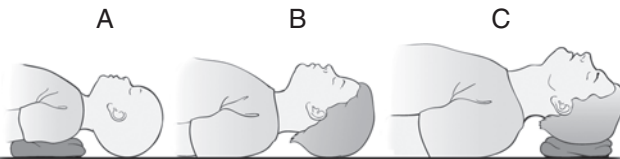


Figure 6. Placement of a pillow to assist airway alignment in an infant (A), a small child (B), and an older child or adult (C). (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5]. St Louis: Mosby, 2007, p 452; redrawn from Walls RM, Murphy MF, Luten RC, Schneider RE [eds]: *Manual of emergency airway management* [ed 2]. Philadelphia: Lippincott Williams & Wilkins, 2004.)



Figure 7. Head tilt with chin lift to bring the base of the tongue forward and open the airway. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5]. St. Louis: Mosby, 2007, p 453; redrawn from Mahadevan SV, Garmel GM [eds]: *An introduction to clinical emergency medicine: guide for practitioners in the emergency department*. Cambridge, UK: Cambridge University Press, 2005. © Chris Gralapp, www.biolumina.com.)

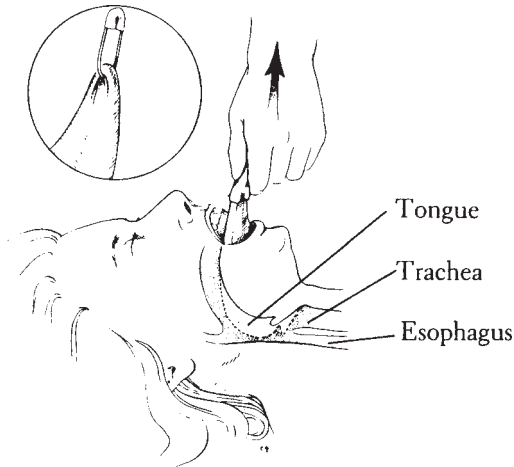


Figure 8. Manual tongue traction. With a cloth or safety pin (inset) to secure the grip, the tongue is lifted out of the mouth to clear the airway.

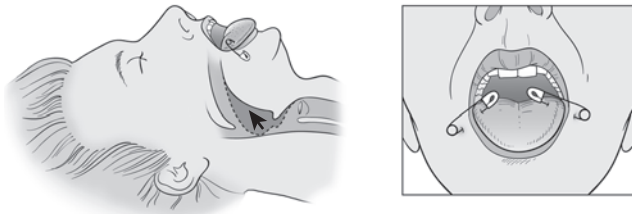


Figure 9. Using two safety pins to attach the tongue to the face just below the lower lip to help control the airway. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5]. St. Louis: Mosby, 2007, p 506.)



Figure 10. Victim on his side to minimize choking. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5]. St. Louis: Mosby, 2007, p 456.)

5. Choking is a life-threatening condition in which the upper airway (above the vocal cords) is obstructed by a foreign object (tongue, broken teeth, dentures, food). The choking person is profoundly agitated (until he becomes unconscious from lack of oxygen), may appear to be panicked with bulging eyes, may grasp at his throat in a choking gesture, cannot breathe, and is unable to speak. You must respond rapidly:

Sweep the mouth with one or two fingers to remove any foreign material. Take care not to force material farther into the throat. Quickly extract loose dentures.

Using an open hand, give the victim two to four rapid, sharp blows on the back between the shoulder blades. This may be more effective if the victim is lying on his side or is bent forward at the waist. If a small child is choking, perform this maneuver while holding him facedown or upside down. If the victim is an infant, place him facedown on one of your forearms, with his head lower than his body. Support his head. Give five quick back blows, then turn the infant over and give five quick chest thrusts (similar to those given during cardiopulmonary resuscitation [CPR]—see page 32).

Perform the Heimlich maneuver (Figure 11). Position yourself behind the victim and encircle him with your arms, clasping your hands in a fist in the upper abdomen just below his ribs. Squeeze the victim suddenly and firmly (“bear hug”) two or three times, in an attempt to produce a brisk exhalation (cough) and ejection of the foreign (choking) material. If your

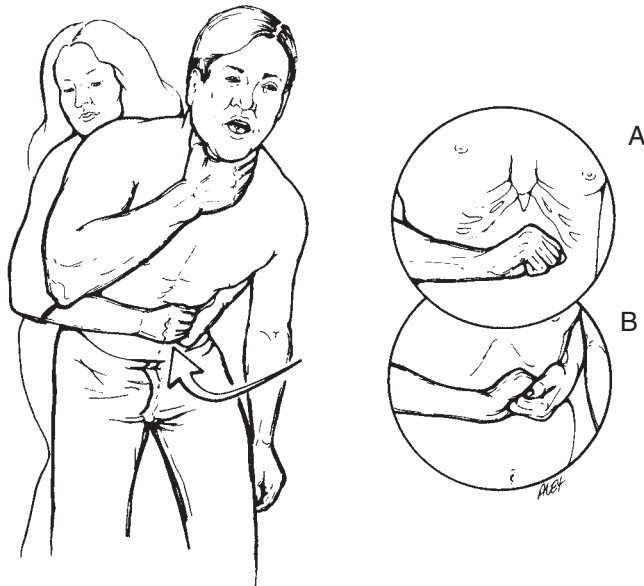


Figure 11. The Heimlich maneuver. **A**, A hand is placed on the upper abdomen. **B**, The second hand interlocks to create a tight grip. A sudden, forceful squeeze (“bear hug”) causes the victim to cough.

first attempt is unsuccessful, alternate back blows with the Heimlich maneuver. If you are the victim and no one is present to help during a choking episode, you can throw yourself against a log or table edge in an attempt to perform a self Heimlich maneuver.

If the victim is lying on his back (supine), perform the Heimlich maneuver by sitting astride his thighs, facing his head (Figure 12). Place the heel of one hand on his upper abdomen and cover it with your other hand. Press into the abdomen suddenly and firmly in a direction toward the chest. Do this a few times, and then perform the chin lift (see step 1 on page 23) and sweep a finger deeply through the mouth to extract any foreign material forced up by your efforts. Take care not to push anything back into the throat.

For a child older than 1 year of age, keep him supine (because the child is too large to hold facedown or upside down) and place the heel of your hand well below his breastbone but above his navel.

If the victim is obese or pregnant, apply the force (with the victim sitting or lying down) to the center of the chest (breastbone), rather than the abdomen.

6. If necessary, begin mouth-to-mouth breathing (see page 29).

BREATHING

The act of breathing delivers oxygen to the lungs during inhalation, exchanges oxygen for carbon dioxide in the lungs, transfers oxygen into the bloodstream, and removes carbon dioxide during exhalation. The rate and depth of breathing are controlled by the oxygen and carbon dioxide levels in the blood, by the body's oxygen demand, by the ability of the blood to unload oxygen to the tissues, by

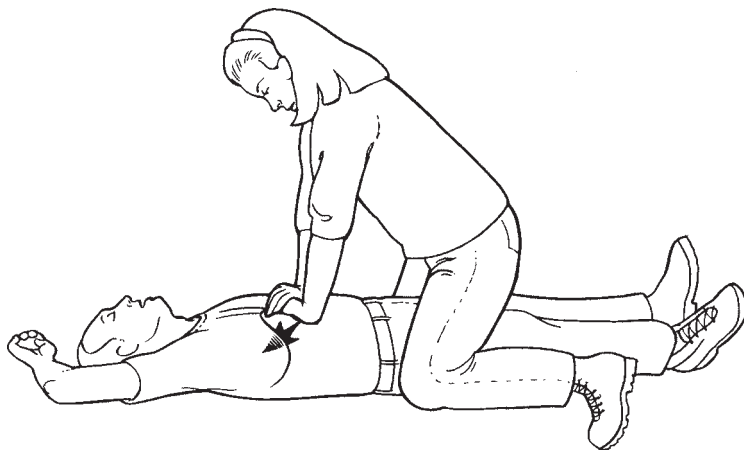


Figure 12. Heimlich maneuver with the victim lying down.

brain and brainstem regulatory sensory systems, and by emotional factors. If there is a head or spinal cord injury, however, the central nervous system stimulus for breathing may be lost. In many instances, this is only transient (lightning strike is a good example); thus, it is imperative to provide breathing assistance for a period of time before giving up hope. Exhaled air from a human contains 16% oxygen, which is enough to support life (via mouth-to-mouth or mouth-to-mask breathing) at low altitudes.

A direct chest injury (broken ribs, fractured breastbone, bruised or collapsed lung) may render respirations inadequate because of pain or mechanical dysfunction. The accumulation of fluid in the lungs because of inhalation (such as in a drowning or burn injury), heart failure, or constriction of the smaller branches of the airway (in asthma or an allergic reaction) may make the work of breathing overwhelming for the victim.

How to Assist Breathing (Mouth-to-Mouth)

1. Position the victim's head in the "sniffing position" by placing one hand under his neck and the other on his forehead, to lift behind the neck (gently) and tilt the head backward (see Figure 5). If you suspect a broken neck, do not move the victim's neck; merely lift his jaw (see Figure 4).
2. Quickly sweep two fingers through the victim's mouth to remove any foreign material. Remove loose dentures.
3. Pinch the victim's mouth closed and cover his mouth with your own (Figure 13). If you have a barrier (pocket mask or mouth shield, such as the NuMask Pocket CPRKIT with one-way valve) to prevent transmission of infectious diseases, use it as directed. An improvised barrier shield for rescue breathing can be created by taking a surgical glove and cutting off the middle finger at the midpoint of its length. The rescuer then stretches the glove across the victim's mouth and nose and blows into the glove

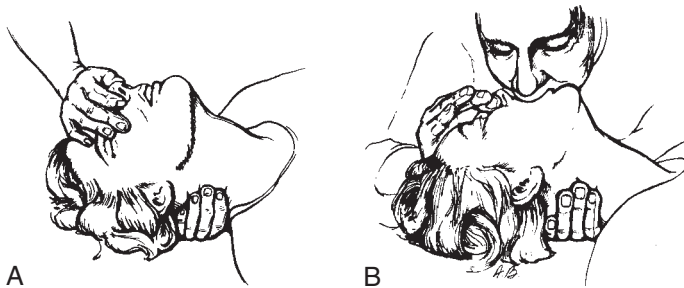


Figure 13. Mouth-to-mouth breathing. **A**, While the neck is supported with one hand, the nose is pinched closed. **B**, The rescuer covers the victim's mouth with his own and forces air into the victim until the chest rises. This should take approximately 1 second.

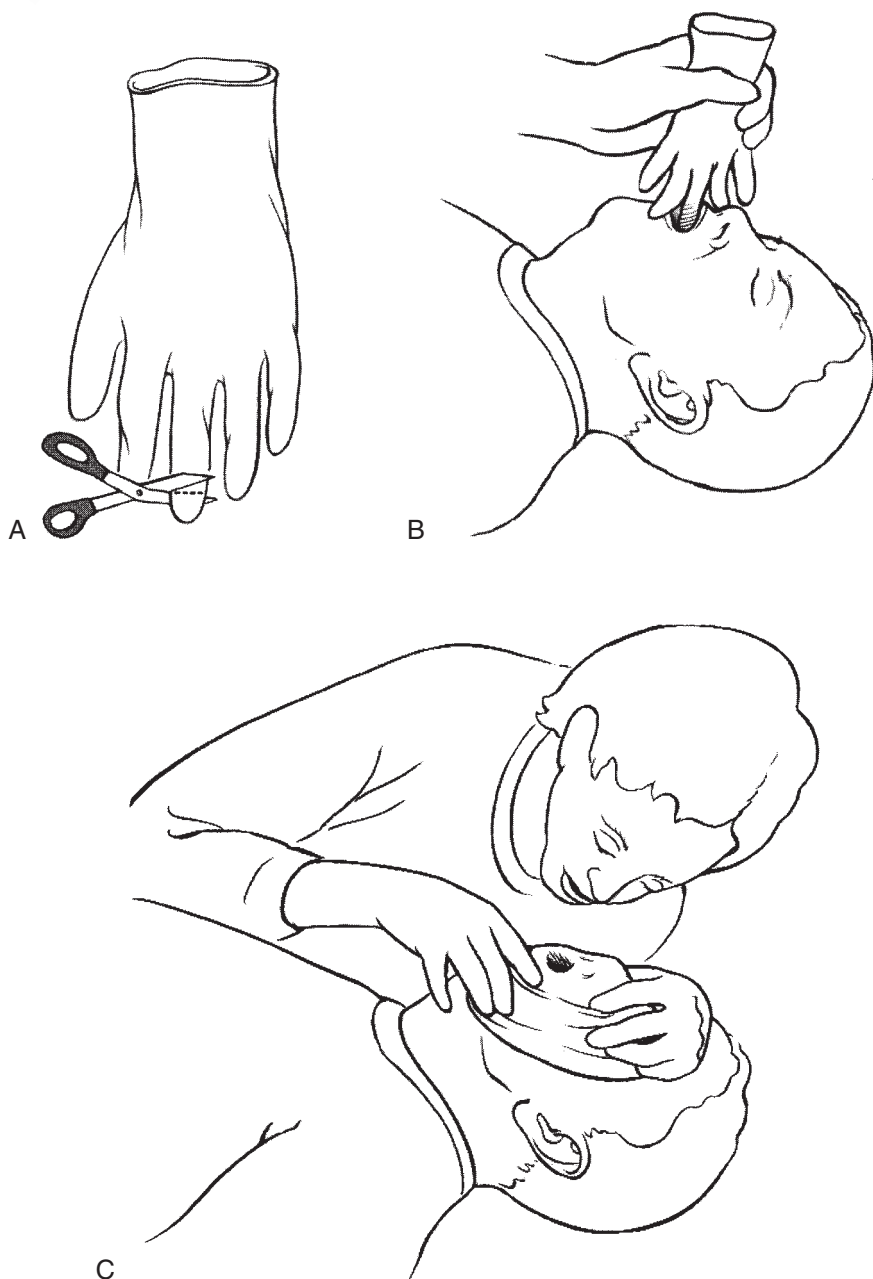


Figure 14. A–C, Improvised CPR barrier fashioned from protective surgical glove.

(Figure 14). After each breath, uncover the nose to allow the victim to exhale. If you are using the jaw lift technique (see step 1 on page 23) to open the airway, press your cheek against the victim's nose to occlude it during mouth-to-mouth breathing. For mouth-to-nose breathing, close the victim's mouth and cover his nose with your mouth. For small children and infants, cover both the mouth and nose with your mouth (Figure 15).

4. Blow air into the adult victim until you see his chest rise. This should take approximately 1 second. Give two full breaths, pausing between them to inhale and see if the chest rises. With small children and infants, do not blow forcefully. If the chest does not rise, be certain the airway is open (proper head position, tongue and mouth clear—see pages 23 to 26). If the positioning is correct and the chest still does not rise, consider an airway obstruction with a foreign body (see page 27). If the victim is not breathing, coughing, or moving after you have provided the first two breaths, prepare to administer the chest compressions of CPR (see page 32).
5. Remove your mouth and allow the victim to exhale passively. Repeat the cycle every 5 seconds for adults, and every 3 seconds for children. If chest compressions are occurring, the ratio is 30 compressions to each 2 rescue breaths for adults and children.
6. If you meet resistance trying to blow air into the victim's lungs, check the head positioning and reclear the mouth. You may need to lift the jaw to pull the base of the tongue up and out of the throat.
7. If it is impossible to blow any air into the victim's lungs, it might be that something is lodged in his airway. Turn the victim on his side and deliver four sharp blows between the shoulder blades, or perform the Heimlich maneuver (see page 27).
8. Mouth-to-mouth breathing usually forces air into the victim's stomach as well as into his lungs. If the stomach fills up with so much air that it becomes tense and you cannot expand the lungs, turn the victim quickly on his side and press on the abdomen. This may make him vomit, so be prepared to clean out the mouth.



Figure 15. Mouth-to-mouth-and-nose breathing required to resuscitate a child.

CHECK FOR PULSES (CIRCULATION)

Assess the need for cardiopulmonary resuscitation (CPR). Current American Heart Association guidelines advise laypersons to begin chest compressions without going through a pulse check on victims who are not breathing and who do not show any sign of life. If an automatic defibrillator is available, a single shock may be administered.

Basic life support may also be initiated by checking for a pulse. Check for pulses for 10 seconds at the neck (carotid artery: Figure 16, A) or groin (femoral artery: Figure 16, B). Use the tips of your index and middle fingers to feel for a pulse. Do not use your thumb, because this finger often has pulsations of its own, which you may confuse with the victim's pulse.

Do not rely on the wrist (radial or ulnar artery: Figure 16, C and D) for the determination of heartbeat. The carotid artery is located (see Figure 16, A) at the level of the Adam's apple, between this structure and the large muscle (sternocleidomastoid) that runs from the base of the ear to the collarbone. Pulsations from the femoral artery may be felt (see Figure 16, B) below the abdomen in the groin crease where the front of the leg attaches to the trunk, two finger-breadths medial (toward the center) to the midpoint in the line from the hipbone (anterior iliac spine) to the bony region directly under the pubic hair (the pubic symphysis). Other locations where the pulse may be felt (often with great difficulty) are on the inner aspect of the elbow (brachial artery: Figure 16, E); behind the knee (popliteal artery: Figure 16, F); directly behind the bony prominence (malleolus) on the inner side of the ankle (posterior tibial artery: Figure 16, G); and centrally on the top of the foot (dorsalis pedis artery: Figure 16, H).

A normal resting pulse rate is 55 to 90 per minute for adults, 80 to 110 per minute for small children, and 100 to 130 per minute for infants. A well-conditioned athlete will often have a resting pulse rate of 45 to 50 per minute, because the well-developed vagus nerve's impulses dominate. Failure to feel a pulse means that the heart is not beating (cardiac arrest), the pump (heart) is not squeezing with sufficient force (profound shock or hypothermia), the artery is constricted (hypothermia), there is an injury to the artery (from a fracture or severe cut), or you are feeling in the wrong place.

If no pulse is detected (and the victim is unconscious and not breathing), send someone for help, give two breaths to the victim (see page 29), and begin the chest compressions of cardiopulmonary resuscitation (CPR).

Chest compressions are performed as follows:

1. Place the victim on his back on a firm surface and position the heel of one of your hands over the center of his breastbone (Figure 17, A). The heel of your second hand is placed over the bottom hand. Interlock your fingers (Figure 17, B) and keep them held lightly off the victim's chest.
2. Your shoulders should line up directly over the victim's breastbone, with your arms straightened at the elbows (Figure 18).

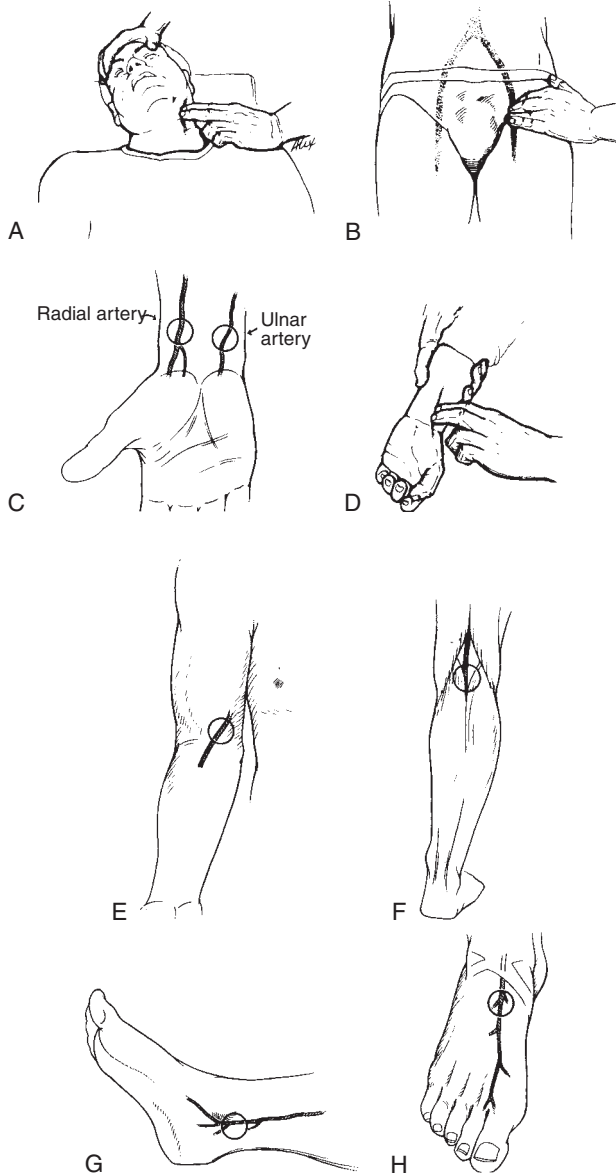


Figure 16. Location of the pulses. **A**, Carotid artery in the neck. **B**, Femoral artery in the groin. **C**, Radial and ulnar arteries in the wrist. **D**, Taking a radial pulse. **E**, Brachial artery in the arm. **F**, Popliteal artery behind the knee. **G**, Posterior tibial artery on the inner aspect of the ankle. **H**, Dorsalis pedis artery on the top of the foot.

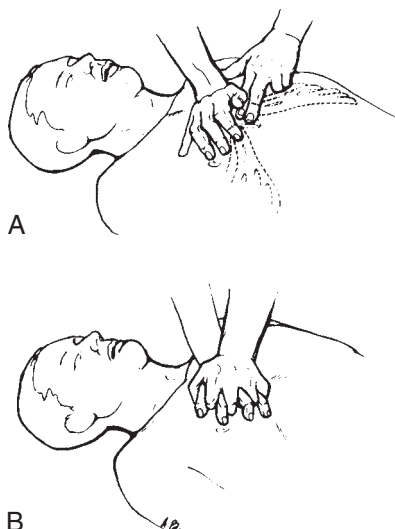


Figure 17. Positioning the hands for cardiopulmonary resuscitation (CPR). **A**, The heel of the first hand is placed two fingerbreadths above the bottom edge of the breastbone. **B**, The second hand is placed over the first and the fingers are interlocked.

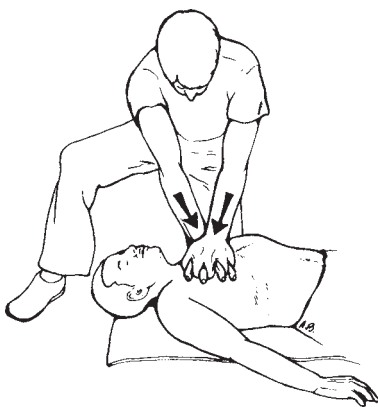


Figure 18. Proper arm and body position for CPR. The rescuer compresses the victim's chest by keeping the arms straight and dropping his upper body weight directly over the victim.

3. Using a stiff-arm technique, the breastbone is compressed 1.5 to 2 in (3.8 to 5 cm) and then released (Figure 19). Keep your motions smooth. The compression phase should equal the relaxation phase, with a rate of 100 compressions per minute for adults and children. Give an initial 30 compressions. With single-rescuer CPR, try to maintain a ratio of 30 compressions interrupted by two mouth-to-mouth breaths (see page 29). After

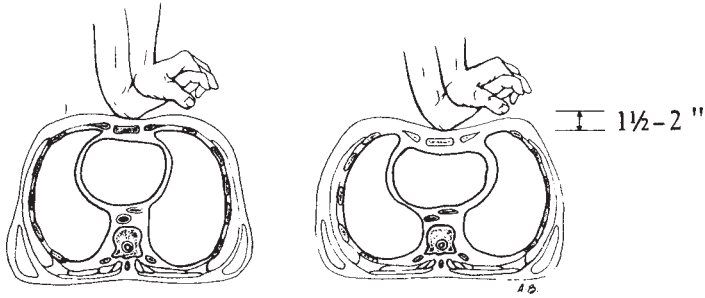


Figure 19. Compression of the chest during CPR. With proper technique, the adult/child breastbone should be compressed 1.5 to 2 in, with 100 compressions per minute.

the first four cycles of compressions and breaths, check for pulses and spontaneous breathing. If both are absent, resume your efforts, checking for signs of life every few minutes.

4. If two rescuers are working together, the second rescuer should give the victim mouth-to-mouth resuscitation, forcing two breaths into him with every 30 chest compressions. The artificial breaths should be provided during a brief pause between compressions.
5. Continue CPR until you are relieved by someone, you become exhausted, the victim is revived, or a qualified person pronounces the victim dead. Situations in which CPR is unlikely to revive a victim include cardiac arrest associated with severe injuries, drowning in which the victim has been submerged for more than an hour (with the rare exception of cold-water immersion—see page 305), the victim having an incompressible chest (extreme cold or prolonged “downtime” with rigor mortis—see page 309), and after 30 minutes of resuscitation effort without any victim response (breathing or pulse).

Chest compressions in infants and small children can be performed by placing a stabilizing hand on the child’s back and compressing hand (or fingers) on the chest (Figure 20). With a small child, use one hand to perform the compressions. With an infant, use two fingers. Care should be taken to provide firm compressions without separating the ribs from the breastbone. The rate of chest compressions for a child is 100 per minute at a depth of 1 to 1.5 in (2.5 to 3.8 cm), with a breath after each 30 compressions. For an infant, the rate of compressions is 100 per minute at a depth of 0.5 to 1 in (1.3 to 2.5 cm), with two breaths after each 30 compressions.

Continue to administer rescue breathing and chest compressions until help arrives or you become too tired to continue. Miraculous survivals have been reported in victims of prolonged cardiac arrest from cold-water submersion or lightning strike. During a resuscitation, the rescuer(s) should check every few minutes for return of a pulse or spontaneous breathing. During the first 5 to 7 minutes of CPR, if you cannot do both mouth-to-mouth breathing and chest compressions for whatever reason, do the compressions only.

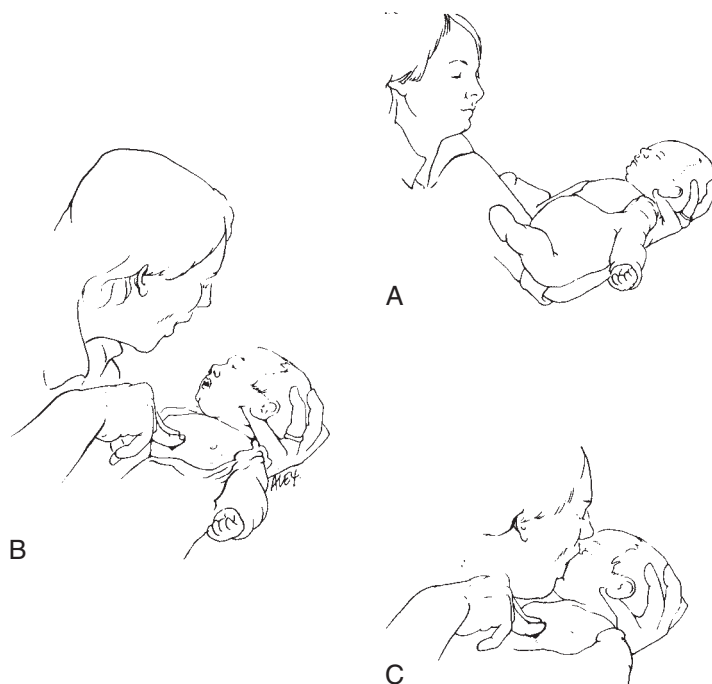


Figure 20. Infant CPR. **A**, Positioning the infant on the forearm. **B**, With the forearm for a back support, two fingers of the opposite hand are used to compress the breastbone. **C**, The mouth and nose of the infant are covered by the rescuer's mouth for artificial breathing.

If you have access to an automated external defibrillator (AED), attach it to the victim as soon as possible, so that it can determine whether or not a shock (for ventricular fibrillation, in which the heart does not contract, but quivers in such a fashion as to be unable to pump blood) is indicated. If the AED shocks the victim, check for a pulse and breathing. If the victim continues to require chest compressions because a pulse is not present, continue CPR for 2 minutes, and then use the AED again to determine whether or not a shock is indicated. If a shock is successful in terminating ventricular fibrillation, chest compressions may still be necessary for a minute or two to circulate blood (and oxygen), while the heart restores a life-sustaining rhythm. When pulses return and can be felt, discontinue chest compressions.

The Condition of Death

CPR in a wilderness setting is rarely successful. Unfortunately, your best efforts at resuscitation may be to no avail and the victim will die. Signs of death include no movement or response to pain; no detectable pulse; absent breathing; dilated

(and often irregularly shaped) pupils that do not contract when exposed to bright light; pale or blue-gray skin, fingernails, and lips; penile erection; uncontrolled urination or bowel movement; and cool body temperature. After a period of an hour or two, the muscles become stiff (rigor mortis), the skin mottles, and blood settles visibly in a dependent fashion due to gravity, causing large discolored blotches on the victim's back, buttocks, and legs (if he is kept supine). *However, it is essential to remember that hypothermic individuals, who are extremely cold, may appear to be dead* (see page 309). Therefore, if hypothermia is suspected, "no one is dead until he is warm and dead." In such a case, resuscitative efforts should be carried out until the victim is revived, the rescuers become exhausted or endangered, or a health care professional can pronounce death. This is also true for a victim of lightning strike or cold-water drowning, and for children. If a victim is dead, the body should be decently covered and kept in a cool location until extrication is possible. If foul play is suspected, the body should not be moved.

PROTECT THE CERVICAL SPINE

If a victim has fallen, is unconscious, or has a face or head injury, he may have a fracture of the cervical spine (neck). High-risk situations include falls from a height greater than 10 feet or any fall that involves an elderly person, motor vehicle accidents at speeds over 35 mph or with a death at the scene, drowning, and diving accidents. If the victim has external evidence of a neck injury; complains of midline neck or back pain; or has a tender neck when examined, a broken limb or pelvis pain, altered mentation, head or face injury, chest or back pain, or abnormal sensation or weakness in the hands or feet, be suspicious for an associated cervical spine fracture. In this circumstance, it is prudent to immobilize the victim's head and neck.

Never move the neck to reposition it. You must immediately immobilize the head and neck. The neck can be immobilized by taping the head to a backboard or stretcher, by applying a rigid collar, or by placing sandbags or their equivalent on either side of the head (Figure 21). Do not use bags of snow to hold the head, because these may melt and allow too much motion; they can also contribute to hypothermia (see page 305).

In general, the most dangerous direction of motion for a neck-injured (spinal cord-injured) person is chin to chest (flexed). Circumferential neck collars that prevent flexion can be purchased preformed or be fashioned from cardboard, Ensolite sleeping pad material, foam-covered aluminum (the SAM Splint) (Figure 22), a padded backpack hip belt, or other semirigid materials. For a neck collar to be effective, it must be rigid or semirigid, fit properly, not choke the victim, and allow the victim's mouth to open if he needs to vomit. One way to improvise is to wrap bulky clothing with a wide elastic bandage to compress the material and make it more rigid.

An improvised spine board can be made by inserting a snow shovel through the centerline attachment points of an internal frame backpack. Pad the shovel, then tape the victim's head to the shovel, which serves as a head bed. The pack suspension



Figure 21. Immobilization of the neck using rolled towels. The rescuer's hands may be replaced with a strap of tape across the forehead to prevent movement.

system is used to stabilize the shoulders and torso, so that the victim now has his head relatively immobilized. Another possibility is to invert (turn upside down) an internal or external frame backpack and use the padded hip belt as a head bed.

If a rigid collar cannot be applied without forcing the neck into an unnatural (for the victim) position, it may be better to use a soft collar with rigid reinforcements to prevent motion. For instance, if the victim is an elderly person who normally has a forward curvature of the spine, and can inform you of this, it is better to immobilize the neck in a comfortable (for the victim) position with a slight amount of flexion. Applying force to straighten this particular victim's neck might risk worsening a fracture or even causing a spinal cord injury. In any case, the most important thing is to prevent future unintended motion.

If no other equipment is available and if the victim is conscious and cooperative, a thick pad (rolled towel, jacket, or the like) may be placed at the base of his neck. This can be made more rigid by first wrapping (compressing) it with a wide elastic (Ace) bandage. Secure this by wrapping tape or cloth around the forehead, then crossing it over the pad and bringing it back out under the armpits to be tied across the chest (Figure 23). *Be aware that this technique does not guarantee immobilization in a combative or confused victim.*

In proportion to the torso, the head of a young child is larger than is the head of an adult. Therefore, when a child is flat on his back, his neck may be flexed instead of in a "neutral" position. To overcome this effect, tilt the head back slightly, or place a blanket or pad under the child's torso.

If the victim becomes uncooperative or agitated, you must hold his head until it can be firmly immobilized and the victim restrained from motion (Figure 24; see Figure 21). All of this is necessary to avoid injury to the spinal cord. If the victim must be moved or turned on his side (most commonly to allow vomiting or to place insulation beneath him), hold his head fixed between your



Figure 22. Cervical collar fashioned from a SAM Splint. The malleable foam-covered aluminum allows construction of rigid pillars.



Figure 23. Immobilization of the neck. A rolled towel or shirt is secured behind the neck with a firmly wrapped cravat or cloth. This technique should be used solely for an alert and cooperative victim. It provides only enough support to remind the victim to not move his head and neck.

forearms while you hold his shoulders with your hands. In this way the victim can be “logrolled,” using as many rescuers as possible to avoid unnecessary motion (Figure 25).

Logrolling the Victim (see Figure 25)

The best way to carry and immobilize a person who may have an injured spine is to use a scoop stretcher, or to slide a backboard underneath the victim. However, when these are not available and a spine-injured person must be turned, logrolling is the best alternative.

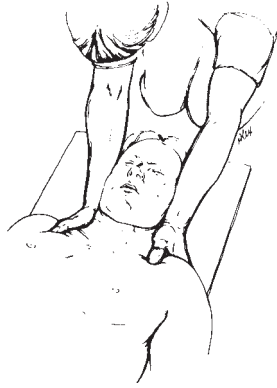


Figure 24. Immobilization of the neck. The rescuer grasps the victim's shoulders and controls the head between his forearms.

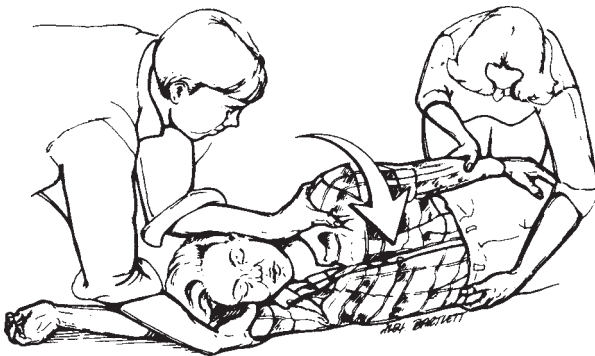


Figure 25. Logrolling the victim. The rescuer at the head immobilizes the neck with his forearms and the victim's extended arm, while an assistant helps turn the body.

1. The first rescuer approaches the victim from the head, and keeps the head and shoulders in a fixed position (no neck movement).
2. The second rescuer extends the victim's arm (on the side over which the victim is to be rolled) above the victim's head. The first rescuer takes this arm and uses it to help support the head in proper position.
3. All rescuers work together to turn the victim without moving his neck.

Lifting a Victim

See page 459.



CHEST INJURY

BROKEN RIBS

Direct force applied to the chest wall can break the ribs, causing extreme pain with breathing, collapse of a lung (pneumothorax), or both. If the right lower ribs are broken, be alert to the possibility of a bruised or cracked liver, which lies directly below; if the left lower ribs are broken, the underlying spleen may be injured.

FLAIL CHEST

If a number of ribs are broken or detached in series, so that the affected section of the chest wall cannot expand and contract in synchrony with the rest of the chest, then a flail chest (Figure 26) is present. Depending on the size of the flail segment, this can cause severe respiratory compromise. Occasionally, the flail segment moves with breathing in a direction opposite to the rest of the chest wall.

PNEUMOTHORAX

A pneumothorax is a collapsed lung created when there is an air leak (from the lung or from a penetrating wound of the chest wall) into the space between the lung and the inside of the chest wall (pleural space). In the normal situation, the pleural space is undetectable and filled with negative pressure, which allows the lung to expand and contract with chest wall movement (breathing). When air leaks into the pleural space, either from a lung injury or from a hole in the chest wall, the lung collapses. The lung may then be increasingly compressed if air accumulates in the pleural space under pressure (Figure 27). A collapsed lung is recognized by diminished or absent breath sounds (heard through a stethoscope or an ear held against the chest wall) on the affected side, accompanied by chest pain, shortness of breath, and difficult breathing. If air accumulates under pressure in the affected pleural space, this becomes a “tension” pneumothorax. It is characterized by rapidly progressive difficulty in breathing associated with a pneumothorax, cyanosis (blue skin discoloration), distended neck (jugular) veins, and a shift of the windpipe away from the affected side.

Rarely, air that escapes from the lung to create a pneumothorax can become trapped under the skin, creating a “crackling” sensation when the skin is pressed, a sensation of fullness or visible swelling in the neck, a change in voice, and

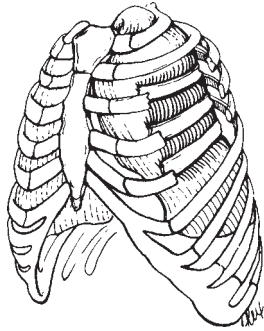


Figure 26. Flail chest. A section of detached (broken) ribs may seriously impede the mechanics of breathing.

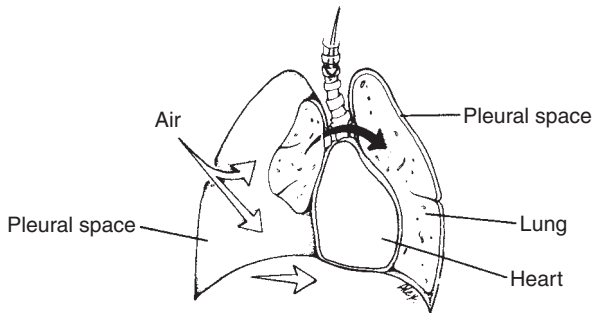


Figure 27. Pneumothorax. Air enters the pleural space lining the lung through the chest wall or from a lung leak, which causes the lung to collapse. A tension pneumothorax occurs when air in the pleural space accumulates under pressure, forcing the lung, heart, and trachea to the opposite side (dark arrow).

difficulty swallowing. While worrisome in appearance, this subcutaneous (under the skin) air absorbs over time and is not nearly as dangerous as a collapsed lung.

BRUISED LUNG

A bruised lung can result whenever sufficient force is applied to the chest wall. This injury typically causes increased difficulty with breathing after a delay of minutes to hours, as blood and tissue fluid accumulate in the injured lung. In a severe case, the victim will cough up clots of blood.

TREATMENT FOR CHEST INJURIES

1. Attend to any chest wounds. All open wounds (particularly those in which air is bubbling) should be rapidly covered, to avoid “sucking” chest wounds that could allow more air to enter the pleural space and thus continue to worsen

a collapsed lung (see page). For a dressing, a Vaseline-impregnated gauze, heavy cloth, or adhesive tape (Figure 28) can be used. The dressing should be sealed to the chest on at least three sides. If the victim develops a tension pneumothorax following a penetrating wound to the chest and his condition deteriorates rapidly (difficulty breathing, cyanosis, distended neck veins, collapse followed by unconsciousness), force a finger through the wound into the chest to allow the air under pressure to escape. If your diagnosis is correct, you will hear a hissing noise as the air rushes out. This allows the lung to partially expand and may save the victim's life. After the release of air from a tension pneumothorax, cover the wound with a dressing and seal only three sides to create a flutter-valve effect (air can exit, but not enter) and prevent a recurrence—which might come with a complete seal.

2. Administer oxygen (see page 431). If an oxygen tank is available, oxygen should be administered at a rate of 5 liters per minute by face mask or nasal prongs. Elderly victims who have been heavy cigarette smokers (chronic obstructive pulmonary disease [COPD]: see page 47) should be watched carefully for signs of decreasing consciousness whenever oxygen is administered. If this occurs (in the absence of head trauma or shock), supplemental oxygen should be discontinued.
3. Assess the rate and adequacy of breathing. Watch for chest rise, feel and listen to the chest, place a hand near the nose and mouth to check for air movement, and observe skin color. If necessary, assist breathing. This may be done with mouth-to-mouth breathing (see page 29) or with a mask device. *If the victim is not breathing, check for pulses and assess the need for cardiopulmonary resuscitation (CPR) (see page 32).*
4. Anyone who has a significant flail chest will be unable to coordinate the muscular act of breathing and will need early assistance. The flail segment should

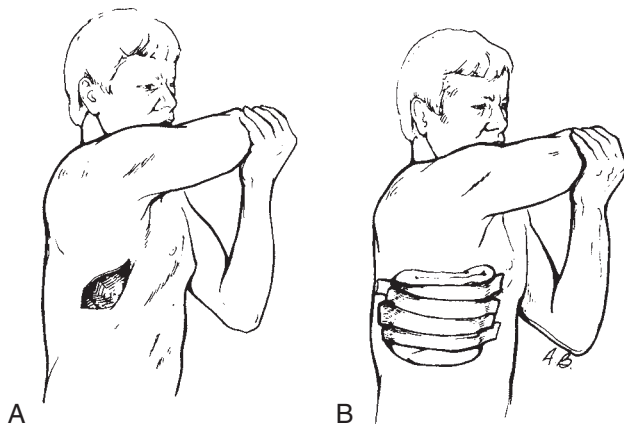


Figure 28. Chest wound dressing. **A**, Open chest wound. **B**, The dressing is held firmly in place with tape or a cloth wrap.

be cushioned firmly with pillows, sandbags, or their equivalent (Figure 29). This prevents movement (pain) and eases the act of breathing. If the victim is lying down, turn him onto the side with the flail segment. This stabilizes the injury and allows the good (upside) lung to more fully expand. Use padding underneath the victim to control pain.

5. Broken ribs are best managed with cushioning in a position of comfort and frequent reevaluation of the ability to breathe. Do not tape or tightly wrap the ribs, because this might prevent complete reexpansion of the chest (lung) with inspiration and therefore predispose the victim to shallow, inadequate breathing and subsequent pneumonia. Encourage the victim to take at least one deep breath or give one good cough each hour.
6. Evacuate the victim as soon as possible. If the chest is injured on one side, transport the victim on his side with the injured side down. This facilitates better expansion of the good (upside) lung and more complete oxygenation of the blood.

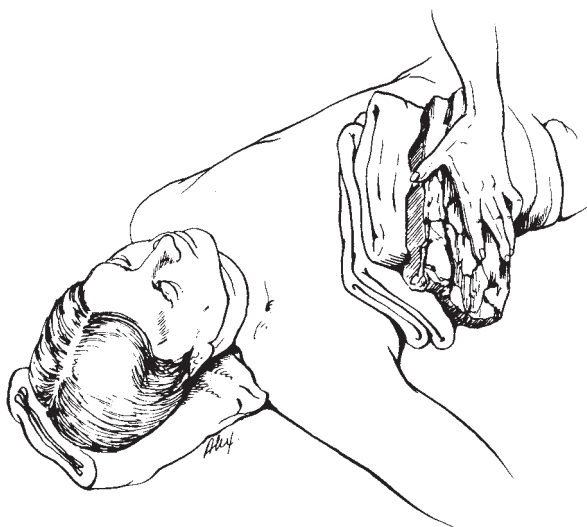


Figure 29. Method of cushioning a flail chest wall segment by applying firm pressure with a blanket and section of tree bark.



SERIOUS LUNG DISORDERS

ASTHMA

Asthma is a disease of the lungs that involves episodes of coughing, shortness of breath, wheezing, and increased secretions in the bronchi. Generally, most people will know that they are prone to asthma attacks; however, a first-time episode may occur during an allergic reaction, on exertion or exposure to cold, or as a result of emotional stress. In most cases, the mechanism is the same: narrowing and spasm of the small airways, with increased mucus production.

The victim has difficulty breathing and wheezing on exhalation (most common), with inspiration, or both. Coughing is a major feature. The victim may become quite anxious (“air hunger”). Severe cases lead to rapid respiratory deterioration, cyanosis (blue discoloration of the skin), and the use of accessory muscles of respiration (the victim sits upright and attempts to expand the chest wall by contracting neck muscles and using body movements). When the attack is extreme, wheezing may diminish, because the lungs become so “tight” that there is not enough air movement to create the abnormal breath sounds.

Treatment For Severe Asthma

1. Administer oxygen (see page 431) by face mask at a rate of 10 liters per minute. If cold weather precipitated the attack, try to get the victim into a warmer climate.
2. Administer an inhaled (aerosol or “micronized”) bronchodilator. Bronchodilators (airway openers) are drugs that carry the advantages of minimal side effects and direct delivery to the site of action. They are available in metered-dose handheld nebulizers (“mistometers”) from which the victim inhales therapeutic puffs. An excellent drug for an acute attack is albuterol (Ventolin). The dose for an adult is two to six puffs initially, followed by two to four puffs every 3 to 6 hours. A mild to moderate asthma episode in an adult can frequently be controlled with an inhaled bronchodilator alone. Young children have difficulty using the inhaler, and therefore may require administration of the drug orally in pill or liquid form. The most effective technique for metered-dose inhalation appears to be discharging the aerosol through a spacer clamped between the lips. The drug should be released (canister pressed down or “triggered”) at the beginning of a deep inspiration. After inhalation, the recipient should attempt to hold his breath for 10 seconds.
3. Administer epinephrine if the victim remains in severe distress after inhalation of a bronchodilator. Epinephrine is a powerful bronchodilator

that is injected subcutaneously (see page 474) as an aqueous solution of 1:1,000 concentration in a dose of 0.3 to 0.5 mL for an adult and 0.01 mL/kg of body weight for a child (not to exceed 0.3 mL). For weight estimation, 1 kg equals 2.2 lb. The drug is not recommended for those known to have coronary artery heart disease (angina or recent heart attack) or older than 45 years. Epinephrine is the treatment of choice for a severe asthma attack in a child. When administering an injection, *never* share needles between people. Epinephrine is available in autoinjectors (EpiPen and Twinject: see page 67) for administration to both adults and children.

4. Administer a corticosteroid. Asthma is often accompanied by inflammation of the airways. The victim should be dosed with prednisone tablets at the earliest possible opportunity, because the onset of their action is delayed by 4 to 6 hours. The dose for an adult is 50 to 80 mg, tapered over 10 days (for example, give 80 mg on days 1 and 2; 60 mg on days 3 and 4; 40 mg on days 5 and 6; 20 mg on days 7 and 8; and 10 mg on days 9 and 10). The initial dose for a child is 1 mg/kg (1 kg = 2.2 lb) of body weight, also tapered over 10 days. If a person with asthma improves greatly (e.g., feels completely normal) after using epinephrine or an inhaled bronchodilator (or both), steroid administration is not absolutely necessary, but in general, it is a highly helpful intervention. If a victim is carrying his own steroid inhaler, have him use it. Similarly, if he is carrying his own ipratropium, this can be self-administered.
5. A person with asthma who is in more than minimal distress or who does not achieve great improvement with these basic pharmacological maneuvers should be transported rapidly to the nearest medical facility. Great care should be taken to keep him well supplied with oxygen and as exertion-free as possible.

PULMONARY EMBOLISM

A pulmonary embolus is a blood clot that has traveled from a vein somewhere in the body to lodge in the circulation of a lung. Such a clot obstructs the flow of blood through a portion of the lung and prevents the normal transfer of oxygen to blood by the affected lung tissue.

The most common sources of the original blood clots are the veins of the pelvis or legs ("thrombophlebitis": inflammation of the veins with blood clots). Predisposing factors to thrombophlebitis include dehydration, underlying disease of the veins (such as varicose veins), injuries, cancer, medications (such as birth control pills), injury, obesity, and prolonged immobility (see page 291). There are hereditary genetic factors as well, such as the presence of factor V Leiden thrombophilia, which results in a tendency to form clots in small blood vessels.

If a person has blood clots in the leg(s), symptoms may include leg pain, warmth, or swelling. This may be present in the calf or deeper down within the thigh with extension into the pelvis.

Symptoms of pulmonary embolism include sudden sharp chest pain (occasionally worse with deep breathing), cough (occasionally with blood), shortness

of breath, increased rate of breathing, light-headedness, and increased or irregular heart rate. The victim may develop a fever. It is often difficult to distinguish pulmonary embolism from pneumonia (see page 48). If the clot is very large, the victim may collapse and die rapidly.

If a person develops symptoms that may represent pulmonary embolism, he should be rushed to medical attention. If oxygen (see page 431) is available, it should be administered by face mask at a flow rate of 10 liters per minute. If the victim can swallow purposefully, administer an aspirin tablet (325 mg) every 24 hours. If a pulmonary embolism is diagnosed, the patient will be treated with a rapid-acting anticoagulant ("blood thinner"), such as heparin or enoxaparin, while being started on a maintenance anticoagulant such as warfarin (Coumadin).

HEART FAILURE (OFTEN CALLED "CONGESTIVE HEART FAILURE")

Failure of the heart muscle to pump blood effectively may occur suddenly (usually with a large heart attack) or start gradually and worsen with time (after a heart attack; with infections of the heart muscle; from prolonged cocaine, anabolic steroid, or alcohol abuse; from chronic anemia; etc.). The symptoms include shortness of breath (particularly with exertion), swollen feet and ankles (fluid retention), bubbling noises in the lungs (fluid in the lungs), cough, wheezing, and blue skin discoloration (cyanosis) noted under the fingernails, around the lips, and at the earlobes. Frequently, a victim of heart failure cannot lie flat to sleep (because fluid collects in the lungs), so he wakes up at night suddenly short of breath.

If a victim with known heart failure suddenly worsens, or if a previously healthy individual develops signs of heart failure (which may represent a new heart attack), he should be kept sitting up, unless he is more comfortable lying on his back. Administer oxygen (see page 431) by face mask at a flow rate of 10 liters per minute, and immediately carry him to medical attention. If the victim must travel under his own power, all exertion should be kept to a minimum. If the victim is awake and alert, you can administer nitroglycerin 0.4 mg by tablet or spray under the tongue. Don't use nonsteroidal antiinflammatory drugs (NSAIDs) in persons with heart failure.

If traveling at high altitude, suspect high-altitude pulmonary edema (see page 339).

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chronic obstructive pulmonary disease (COPD) refers to a number of diseases suffered by people who have exposed their lungs to long-term insults, particularly cigarette smoke. Chronic bronchitis (infection, inflammation, or bronchospasm—see page 205) or emphysema (scarring that leads to lack of elasticity, overinflation, or lung collapse) are the most common subsets of COPD. People with COPD have poor respiratory reserves, and cannot tolerate strenuous exercise or extremes of

environment. A victim of COPD suffers attacks of shortness of breath and coughing similar to asthma, but can get into serious trouble much faster because of underlying debilitation. The earliest signs of respiratory fatigue should be heeded, and evacuation to a restful situation and physician evaluation are high priorities.

With the exception of epinephrine, you may treat a victim of COPD with the same drugs used for the management of asthma. Effective bronchodilator drugs include albuterol, ipratropium, formoterol, salmeterol, and tiotropium. After an exacerbation of COPD, the victim may benefit from a 10-day course of oral prednisone (40 mg per day).

Administration of high-flow oxygen (greater than 1.5 to 2 liters per minute by nasal cannula, or tube) carries a risk, because correction of the low blood oxygen level (hypoxia) in some individuals with COPD will cause them to stop breathing. This is because they have lost sensitivity to high carbon dioxide levels in the blood as a stimulus for breathing (COPD victims always have a relatively high level of carbon dioxide in the blood), and administration of oxygen removes the remaining stimulus (hypoxia) for breathing. Therefore, any person with COPD who is given oxygen should be watched continuously. If his rate of breathing becomes dangerously slow, or he becomes confused or sleepy, the oxygen flow rate should be lessened. Severe COPD can be catastrophic. If necessary, the person may need to have his breathing assisted.

If a person with COPD shows signs of bronchitis (see page 205) or pneumonia (see below), the first-line antibiotic should be trimethoprim-sulfamethoxazole, amoxicillin, doxycycline, tetracycline, azithromycin, clarithromycin, levofloxacin, or sparfloxacin. Second-line antibiotics include ciprofloxacin, cefixime, cefprozil, ofloxacin, and amoxicillin-clavulanate.

PNEUMONIA

Pneumonia is an infection of the lung(s) characterized by combinations of fever, shaking chills (often with chattering teeth), cough, painful and difficult breathing, chest pain, weakness, and the expectoration of discolored (red, green, yellow, brown) phlegm. Pneumonia may evolve from bronchitis (see page 205) or arise independently. In toddlers or young children, rapid breathing, abdominal pain, poor appetite, and vomiting may be the presenting complaints.

Treatment for Pneumonia

1. If respiratory difficulty is extreme, administer oxygen (see page 431) at a flow rate of 5 to 10 liters per minute by face mask.
2. Administer an antibiotic. Although many different bacteria, viruses, mycoplasmas, fungi, and other agents can cause pneumonia, the organisms most commonly acquired outside the hospital ("community acquired") respond to the following drugs (for people under age 60 years): azithromycin (500 mg the first day, then 250 mg a day for 4 more days),

clarithromycin (500 mg twice a day for 10 days), doxycycline (100 mg twice a day for 10 days), or levofloxacin (500 mg a day for 10 days). If one of these is not available, use cefdinir (300 mg twice a day), cefpodoxime (400 mg twice a day), cefprozil (500 mg twice a day), cefuroxime axetil (500 mg twice a day), or amoxicillin-clavulanate (875 mg twice a day). A person over age 60 years or who is debilitated should be treated with levofloxacin or amoxicillin-clavulanate. For a child 4 months to 6 years of age, use amoxicillin-clavulanate, azithromycin, erythromycin-sulfisoxazole, or cefuroxime axetil. For an infant 3 weeks to 3 months of age, use erythromycin or azithromycin.

3. Evacuate the victim.

Serious lung problems related to specific environmental conditions are discussed in the sections on altitude illness (see page 335), drowning (see page 406), and smoke inhalation (see page 115).



Chest pain may be a manifestation of a variety of disorders, ranging from a harmless chest cold or heartburn to a life-threatening heart attack. To try to attain a diagnosis, it is important to ask these questions:

1. Where is the pain?
2. What is the nature of the pain?
3. How severe is the pain?
4. How long have you had the pain?
5. Does the pain extend into the arm, neck, jaw, or abdomen?
6. What relieves the pain?

ANGINA PECTORIS

Angina pectoris (“angina”) is caused by narrowing or obstruction (spasm or actual occlusion) of the coronary arteries, which supply the heart muscle. The pain, which lasts from 3 to 15 minutes, is most often described as heavy and

pressure-like (“squeezing,” like a weight on the chest); it is classically located beneath the breastbone (but may also commonly be present in the left front chest), with occasional radiation to the jaw, back (between the shoulder blades), and left arm. Rarely, it can radiate to the right arm. Associated symptoms include nausea, sweating, shortness of breath, anxiety, and weakness. It is commonly associated with exertion, emotional stress, or both, and may be more frequent at high altitudes (this is debated by doctors), where less oxygen is available. Symptoms are sometimes worse in cold weather or after meals. “Atypical” angina is pain that occurs at rest or that awakens a victim from sleep. Women more commonly have nonclassic symptoms of angina than do men. These include irregular heartbeat, “sharp” or “stabbing” pain, pain that can be reproduced by pressing on the chest, and pain that is localized to underneath the breast. Additional symptoms in elders include shortness of breath with exercise, weakness, or sweating. A first-time angina episode, change in the pattern of existing angina episodes, or increased frequency of episodes may portend a heart attack. Angina may be relieved by rest. Persons with known angina are generally prescribed drugs: nitrates (e.g., isosorbide dinitrate), beta-adrenergic blockers (e.g., metoprolol), or calcium channel blockers (e.g., nifedipine, verapamil, or diltiazem). They also may be taking low-dose aspirin and a “statin” drug to achieve target lipid (e.g., cholesterol) levels. Any person who is taking a nitrate should not be prescribed medication for erectile dysfunction (e.g., sildenafil citrate [Viagra]).

The person who suffers from angina should be kept at absolute rest (sitting or supine) until the pain subsides. If he is carrying his medications, he should place a nitroglycerin tablet (0.4 mg) under his tongue (the tablet dissolves) or use sublingual nitroglycerin spray. If pain persists, this may be repeated after 3 to 4 minutes (not to exceed three tablets or spray applications in 10 minutes). Unless the victim is completely familiar with his angina and declares the episode typical and completely resolved, he should be transported with minimum exertion to an appropriate medical facility. If no relief is obtained, the victim may be suffering a heart attack. Expect a person with chest pain to trivialize his symptoms and deny the possibility of a heart attack.

There is a rare phenomenon, known as myocardial (heart) stunning, which is a severe, reversible abnormality in which a person without coronary artery disease suffers chest pain or decreased heart pump effectiveness (resulting in low blood pressure) when faced with a profound emotional stress, such as death of a parent or extreme fear. The precise mechanism is unknown, but the hypothesis is that this might be caused by an outpouring of “stress hormones.” This is one more reason why it is important to try to keep emotions under control in a stressful situation.

HEART ATTACK (ACUTE MYOCARDIAL INFARCTION)

This is an emergency, because it may rapidly lead to complete cardiac arrest (standstill). A person suffering a heart attack will usually show some or all of the following symptoms: crushing substernal (under the breastbone) chest

pain that may extend into the back, left arm or both arms, or neck; shortness of breath; profound weakness; nausea or vomiting; pale, moist, and cool skin; sweating; agitation; abnormal heart rate and rhythm—slow, fast, or irregular; and collapse. Typically, the chest pain does not subside with the administration of nitroglycerin. When cardiac arrest occurs, the victim stops breathing and has no heartbeat. Any elderly person with chest pain requires prompt physician evaluation.

A “silent” heart attack, in which there is a paucity of symptoms, more commonly occurs during sleep or in a diabetic victim.

Aortic Dissection

Aortic dissection refers to a tear in the aorta, commonly associated with a prior history of high blood pressure. The classic symptoms include sudden “tearing” (sharp) chest pain, which can be unbearably intense. It reaches maximal intensity almost immediately, and may be described by the victim as if a knife was being stuck in the chest. The pain may spread to the jaw, neck, arms, between the shoulder blades, or into the back. This is a true emergency, so if suspected should lead to prompt evacuation.

Treatment for a Heart Attack

1. Send someone for help.
2. If the victim has a pulse and is breathing, he should be kept at absolute rest and arrangements should be made for immediate transport to a medical facility. Administer one aspirin tablet (325 mg) by mouth. If oxygen is available, it should be administered by face mask at a flow rate of 5 to 10 liters per minute.
3. If the victim collapses, *assess the need for cardiopulmonary resuscitation (CPR)* by feeling for a pulse (see page 33) and checking for breathing (see page 12). If these are absent, begin CPR (see page 32).

RAPID HEART RATE

Supraventricular tachycardia (SVT), sometimes called paroxysmal atrial tachycardia (PAT), is a disorder that causes a person’s heart to beat very rapidly, sometimes up to 250 beats per minute. This can make the victim extremely uncomfortable, with a sensation of pounding or fluttering in the chest, palpitations, chest discomfort or tightness, anxiety, light-headedness, shortness of breath, nausea, or weakness. If he is not carrying appropriate medications to treat this syndrome, you might try having the victim bear down and hold his breath as if straining to lift a heavy weight, or immerse his face in a pool of ice water. Another technique is to have him close his eyes, then have him press firmly on both eyeballs for

15 seconds to the point of moderate discomfort. Do not suggest this if the victim has glaucoma or recent eye surgery. Rubbing and pressing (“massaging”) one of the carotid arteries (see page 133) in the victim’s neck can sometimes send a reflex signal through the nervous system to the heart to cause it to slow to a normal rate (“break” the SVT). Carotid artery massage must be done in elders with extreme caution, because on rare occasion it has been noted to precipitate a stroke (see page 144). SVT is definitively treated by a physician with an intravenous injection of a specific medication (often adenosine), or in a dire emergency with a controlled (synchronized) electrical shock to the heart. Persons may carry medications to control or treat SVT. These include diltiazem (or another calcium channel blocker), metoprolol (or another beta blocker), and many others.

NONCARDIAC CAUSES OF CHEST PAIN

Infection

Chest pain may be caused by a lung infection, such as pneumonia, bronchitis, or pleuritis. Typically, infection is characterized by pain that is sharp in nature and associated with fever, cough, weakness, and production of colored (non-white) sputum. Deep breathing usually makes the pain worse. The treatment of these disorders is discussed in other sections. Consult the index.

Heartburn

The pain of gastrointestinal upset (in particular, reflux of food and acid from the stomach into the esophagus) may closely mimic angina. Typically, heartburn (reflux esophagitis, or “reflux”) occurs after a large meal, especially when the victim immediately lies down. Foods that are often troublesome include alcoholic and carbonated beverages, coffee, chocolate, and fats. The discomfort radiates sharply from the stomach through the breastbone and into the throat. Pain, belching, and a sour taste in the mouth may indicate a hiatal hernia, which allows reflux of stomach acid back up into the esophagus. Treatment for heartburn is discussed on page 221. If there is any suggestion that angina (see page 49) is present, seek medical attention. Because the symptoms of a heart attack can be easily confused with those of heartburn, any elderly person with chest or abdominal pain requires prompt physician evaluation.

Muscle Injuries

Heavy physical exertion can lead to overuse syndromes. The pain is related to muscle motion and is accompanied by pain with motion and soreness to the touch. Treatment for these injuries is discussed on page 284.

Costochondritis

Costochondritis is an irritation of the cartilaginous ends of the ribs where they attach to the sternum (Figure 30). The pain is sharp and well localized to the breastbone and adjacent rib ends. It is worsened considerably by pressing on the area or by deep breathing. Occasionally, slight painful swellings of the rib ends can be felt. The treatment is administration of aspirin or a nonsteroidal anti-inflammatory drug (such as ibuprofen).

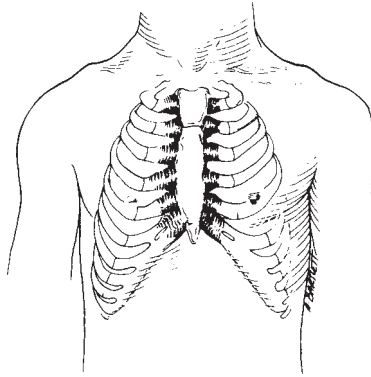


Figure 30. Costochondritis. The attachments of the ribs to the breastbone are inflamed and exquisitely tender to pressure.



BLEEDING

For a discussion of wound management (cleaning, closing, and dressing), see page 260.

Whenever you are going to be exposed to blood or other potentially infectious body fluids, wear sterile latex rubber gloves from your first-aid kit. If you are allergic to latex, use other nonpermeable gloves (such as nonlatex synthetic).

While it is occasionally visually distressing, bleeding can be one of the easiest problems to manage, because the treatment options are so straightforward. The

severity of the injury determines the rate of blood loss and what measures you must take to control the bleeding. Evaluate the following considerations:

1. Where is the bleeding? It is important to consider and identify internal bleeding as well as external bleeding. Considerable blood loss can be associated with blunt (nonpenetrating) abdominal injury (liver, spleen), as well as long bone or pelvic fracture (2 quarts, or liters, of blood can rapidly accumulate in the thigh following a broken femur). *Examine the entire victim!*
2. Is the bleeding from an artery or from a vein? Because arterial blood is under higher pressure, blood loss tends to be more rapid from a severed artery than from a vein. Arterial bleeding can be recognized by its spurting nature and rapid outflow. All blood exposed to air, in the absence of unusual drug intoxications, turns red fairly quickly, so you cannot rely on color to indicate origin.

TREATMENT FOR BLEEDING

First, remove all clothing covering the wound so that you can see precisely where the bleeding is coming from. *Almost all external bleeding stops with firm, direct pressure.* This should be applied directly to the wound with the heel of your hand, using the cleanest available thick (four or five thicknesses of a 4 in by 4 in—or 10 cm by 10 cm—sterile gauze pad, for instance) bandage or cloth compress (Figure 31). Maintain pressure for a minimum of 10 minutes, to allow severed vessels to close by spasm (an artery contains small amounts of muscle tissue in its walls) and to allow early blood clot formation. Peeking at the wound under the compress interrupts the process and prolongs active bleeding. The application of cold packs or ice packs over the compress (*not* under it) may hasten the process by initiating spasm and closure of disrupted blood vessels. It is also useful to have the victim lie down, and to elevate the bleeding part above the level of his heart. A scalp wound tends to bleed freely, and may require prolonged pressure or wound closure for control (see page 65).

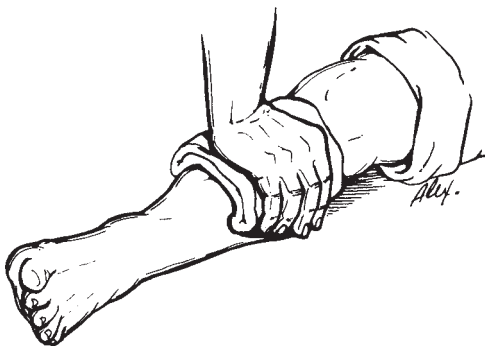


Figure 31. Firm pressure applied to a bleeding wound.

If direct pressure to the wound does not stop the bleeding, you must make certain that you are applying the pressure in the correct spot. Check quickly to see that you are pressing precisely over the bleeding point. If you are a fraction of an inch off, you can miss the best compression spot for a torn blood vessel; in this case, simply piling on more bandages may not solve the problem. Once you have repositioned your pressure, wait again for 5 to 10 minutes. If the pressure appears to be working, once the bleeding has substantially subsided you can apply a pressure dressing. Do this by covering the wound with a thick wad of sterile gauze pads or the cleanest dressing available, and wrapping the area firmly with a rolled gauze or elastic bandage. Do not apply the dressing so tightly that circulation beyond it is compromised (as indicated by blue fingertips or toes, or by numbness and tingling). Watch the dressing closely for blood soaking and dripping, which indicate continuous bleeding.

A very useful product for bleeding is a nonmedicated BloodStopper gauze bandage. Another alternative is the medicated QuikClot adsorbent hemostatic gauze (Z-Medica Corporation), which delivers a zeolite-based clotting agent. This product is also available in a mesh 3.5 in by 3.5 in “sponge” configuration as QuikClot Sport (with or without silver as an antibacterial agent). BleedArrest (Hemostasis, LLC) particles and sponges utilize a natural biopolymer to control severe external bleeding. Celox (hemostatic granules) is a new high-performance hemostatic material that has been created to control high-volume arterial bleeding. Composed of a proprietary marine biopolymer (including Chitosan), it is poured as a granular mixture into a bleeding wound, where it helps to facilitate blood clot formation without causing any tissue damage. It is thought to do this by aggregating negatively charged red blood cells, which are attracted to the positively charged granules. According to promotional material distributed by Sam Medical Products, the granules assist a clot to form within minutes without generating any heat, burning sensation, or rigid structure formation within the wound. A gelled mass formed by excess granules protects the clot and is easy to remove.

Chitosan is manufactured by chemical modification of chitin, which is the structural element in the exoskeleton (“external” skeleton) of crustaceans (crabs, shrimp, and so forth). It carries a positive charge, wherein lies its value for this particular application. Chitosan is not known to commonly invoke an allergic reaction, and can be sterilized. Notably, it is present in other products designed to control bleeding from wounds, such as bandages (ChitoFlex Hemostatic Dressing) marketed by HemCon Medical Technologies Inc.

Celox works in hypothermic conditions and also on blood that has been heparinized (e.g., a person being treated with this category of “blood thinner” or, presumably, with enoxaparin [Lovenox]). There is no mention of whether or not it has been or would be expected to be effective if a victim is currently taking warfarin (Coumadin), which is a common anticoagulant.

To apply Celox, one pours the granules from a sterilized, sealed packet (15 grams or 35 grams) into the wound and then holds them in place with a gauze bandage for 5 minutes. A compression bandage, such as an elasticized

wrap, is then wrapped over the gauze-covered wound and the victim is brought to medical care.

The following are some important things to be aware of with a serious wound:

1. A victim who has lost 25% to 30% of his blood volume may suffer from shock. Treatment is discussed on page 60.
2. Prolonged uncontrollable bleeding is rare unless a major blood vessel or more than one vessel is disrupted, the victim is taking an anticoagulant (blood thinner) medication, or the victim suffers from hemophilia. In such a case, heroic intervention may be lifesaving. The application of extreme compression to “pressure points,” such as the radial, brachial, or femoral arteries, is both difficult and of considerable risk (since the purpose is to cut off all circulation).

A tourniquet is indicated only in a life-threatening situation and is best applied by an experienced person. Only in the case of torrential bleeding is a tourniquet more advantageous than continuous pressure. The decision to apply a tourniquet is one in which a limb is sacrificed to save a life.

A tourniquet should be applied to the limb between the bleeding site and the heart, as close to the injury as is effective, and tightened just to the point where the bleeding can be controlled with direct pressure over the wound. The reason for placing it close to the bleeding is to preserve as much living tissue (which is “above” the tourniquet) as possible.

To construct a tourniquet, use a 2 to 4 in (5 to 10 cm) bandage—not something thin (such as a string, wire, or cord) that will cut through the skin. Wrap the bandage around the limb several times, and then tie half or an entire square knot, leaving loose ends long enough to tie another knot (Figure 32, A). Place a stick or stiff rod over the knot, and then tie it in place with the loose ends. Twist the stick until the bandage is tight enough to stop the bleeding, and then secure it (Figure 32, B) in place with another cloth, tape, or circular bandage. If you must leave the victim after applying a tourniquet, and therefore can no longer apply direct pressure, be certain to check that the tourniquet is still effective after you have released pressure.

If possible, the tourniquet or a pressure-point occlusion should be released briefly every 10 to 15 minutes to see if it is still necessary. Some authorities recommend loosening it after 5 minutes, which might be all right if the bleeding is not torrential. If the bleeding can now be controlled with direct pressure, don’t retighten the tourniquet, but keep a very close watch on the situation. If the original wound damaged or severed a very large blood vessel, it is likely that you will need to keep the tourniquet in place for more than 10 minutes. Always keep a tourniquet in plain view, so that it doesn’t get left in place longer than necessary just because someone didn’t know or forgot it was there. After a tourniquet has been in place continuously for 6 or more hours, do not remove it until you reach advanced medical care.

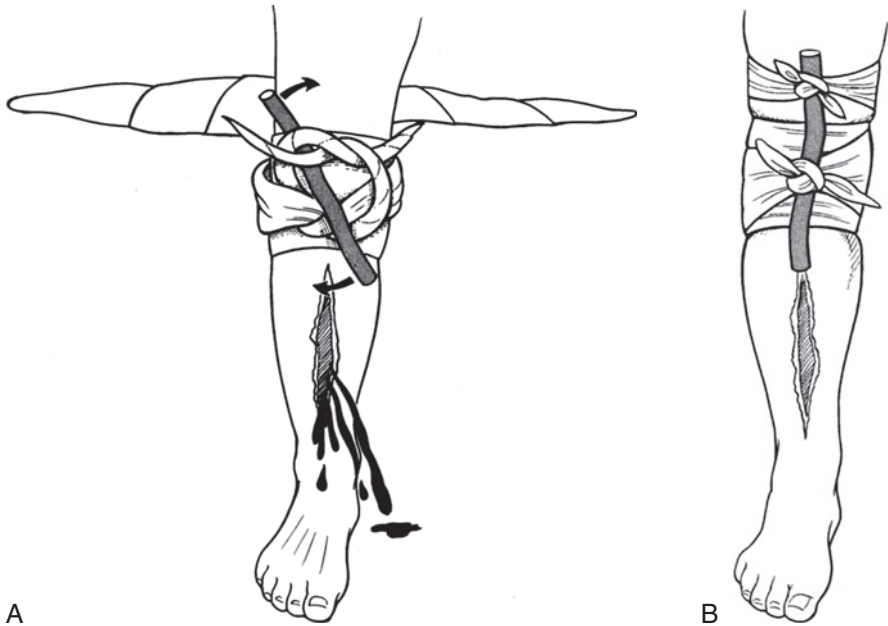


Figure 32. Application of a tourniquet. **A**, Wrap the bandage around the limb, and then tie a square knot. Tie a stick in place over the knot. Twist the stick to tighten the tourniquet just until the bleeding stops. **B**, Secure the stick.

3. If the victim has suffered a large wound through which internal organs (such as loops of bowel) (Figure 33, A) or bones (see page 71) are protruding, *do not attempt to push these back inside the body or under the skin unless they slide back in without your assistance*. Cover extruded internal organs or bones with continually moistened bandages (pads of gauze or cloth) held in place without excess pressure (Figure 33, B). Seek immediate medical attention.
4. If the victim has suffered a severe cut in his neck, take special care to not disturb the wound, because such disturbance might remove a blood clot that is controlling the bleeding from a large blood vessel. Apply a firm pressure dressing (don't choke the victim with the bandage) and seek immediate medical attention. Continually assess the airway (see page 22), because an expanding blood clot within the neck can compress the throat and windpipe. If the victim begins to have raspy breathing or a changed voice, evacuation is maximally urgent.
5. Bleeding can be quite brisk from a ruptured or torn varicose (dilated) vein in the leg. This can usually be managed with direct pressure, while elevating the leg. Follow this with a pressure dressing.
6. If a foreign object (such as a knife, tree limb, or arrow) becomes deeply embedded (impaled) in the body, do not attempt to remove it, because the

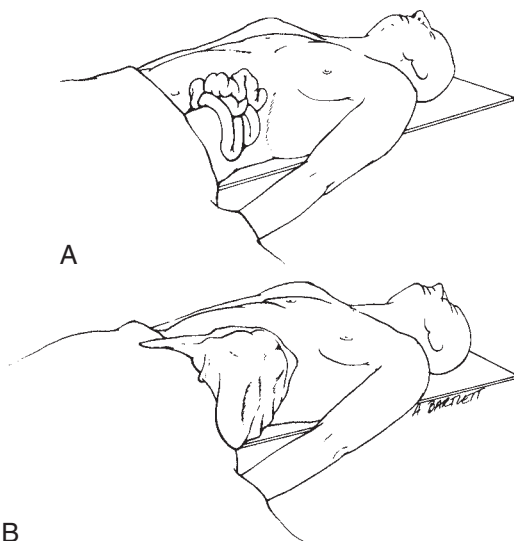


Figure 33. A, Loops of bowel protrude from a laceration in the abdomen. **B,** These should be covered gently with a moistened bandage or cloth. Don't try to push them back into the abdomen unless necessary for evacuation (for instance, if the victim must walk out under his own power and such activity is forcing more bowel to extrude from the wound).

internal portion may be occluding a blood vessel that will hemorrhage without this “plug.” Any attempt at removal may create more damage than already exists, which includes increasing the bleeding. This is particularly true with a hunting (broadhead) arrow. Instead, pad and bandage the wound around the object, which should be fixed in place with tape if possible (Figure 34). The external portion of the object may be cut to a shorter length (cut off the shaft of the arrow a few inches above the skin, for example), if necessary, to facilitate splinting and transport of the victim.

7. A gunshot wound may cause severe internal damage that is not readily visible from the surface wound. Any victim who has suffered a gunshot wound should be brought to immediate medical attention, no matter how minor the external appearance.

Always disarm the victim. A head-injured or otherwise confused victim carrying a loaded weapon could accidentally create an additional victim. If you don't know how to handle a gun, move the weapon at least several feet away and point it in the direction where accidental discharge will do the least harm.

8. There are “blood stopper” products that can be used to assist in controlling bleeding (see page 55). These include QuickClot Sport (Z-Medica), which is

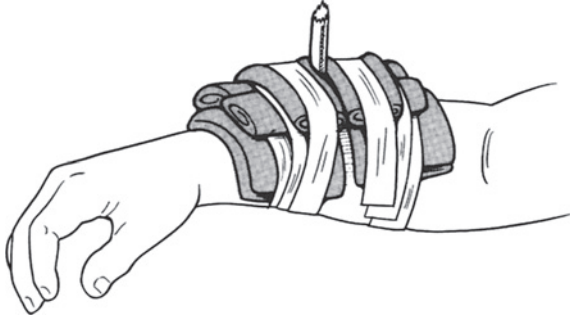


Figure 34. Padding and bandages to prevent motion of a penetrating object.

a porous sack filled with a highly absorbent mineral derived from lava rocks; QR (Biolife LLC), which is a powder composed of tiny plastic beads and potassium salt that is sprinkled on a wound; and bandage and gauze products (such as BloodStop [LifeScience Plus Inc.]) made from cellulose that transform on contact with blood and accelerate clot formation.

9. After the bleeding has stopped, immobilize the injury. Check all dressings regularly to be certain that swelling has not made them too tight.

INTERNAL BLEEDING

If bleeding is internal, such as from a bleeding ulcer, broken bone, injured spleen or liver, leaking abdominal aneurysm, or lung cancer, the victim may suffer from shock. Symptoms of internal (undetected) bleeding are the same as those of external bleeding, except that you don't see the blood. They include rapid heartbeat, shortness of breath, general weakness, thirst, dizziness or fainting when arising from a supine position, pale skin color (particularly in the fingernail beds and conjunctivae), and cool, clammy skin. Other signs include increasing pain and firmness of the abdomen after an injury, vomiting blood or "coffee grounds" (blood darkened by stomach acid), blood in the urine or feces, or large bruises over the flank or abdomen. Because it is difficult to predict the rate of internal blood loss and because the only effective treatment for many causes of severe internal bleeding is surgery, medical help should be sought immediately.



SHOCK

Shock is a condition in which the blood supply (which carries oxygen and nutrients) to various organs of the body is insufficient to meet metabolic demands. The signs and symptoms are restlessness, low blood pressure, weak and rapid (thready) pulse, altered mental status (restlessness, anxiety, confusion), moist and cool (clammy) skin, rapid shallow breathing, inability to control urination and bowel movements, nausea, and profound weakness. It is a life-threatening condition and may follow a large number of inciting events. Causes of shock include severe internal or external bleeding (25% to 30% acute loss of an adult's total blood volume, equivalent to 1.5 to 2 liters out of 6 liters), overwhelming infection, burns, dehydration, heart attack or disease, hormonal insufficiency, hypoglycemia, hypothermia, hyperthermia, allergic reaction, drug overdose, and spinal cord injury (loss of sympathetic nervous system support allows blood vessels to dilate as they lose tone). If shock is caused by blood loss (hemorrhage), the following rough estimates apply:

1. Blood loss of 750 mL to 1 liter corresponds to heart rate ("pulse") of up to 100 beats per minute and respiratory rate of approximately 14 to 20 breaths per minute. Blood pressure may remain normal.
2. Blood loss of 1 to 1.5 liters corresponds to heart rate greater than 100 and respiratory rate of 20 to 30. Blood pressure is decreased.
3. Blood loss of 1.5 to 2 liters corresponds to heart rate greater than 120 and respiratory rate of 30 to 40. Blood pressure is decreased.
4. Blood loss of greater than 2 liters corresponds to heart rate greater than 130 and respiratory rate greater than 35. Blood pressure is decreased.

Shock is a true emergency. Unfortunately, there is little that the rescuer can do in the field. The management of shock includes the following:

1. Position the victim on his back, with the legs elevated about 30 degrees (8 to 12 in or 20 to 30 cm), to encourage blood in the leg veins to return to the central circulation (heart) and head (brain) (Figure 35). Do not elevate the legs if the victim has a severe head injury (see page 61), difficulty breathing, a broken leg, or a neck or back injury, or if such a maneuver causes any pain. If the victim is short of breath because of heart failure (see page 47), he may be more comfortable in the sitting position.
2. Keep the victim covered and warm. Remove him from harsh weather conditions. Remember to insulate him from below. If insufficient bundling is available, lie next to the victim to share body heat. Take special care to keep his head, neck, and hands covered.
3. Administer oxygen (see page 431) at a flow rate of 10 liters per minute by mask.
4. Control any obvious sources of external bleeding (see page 54). Splint all broken bones.

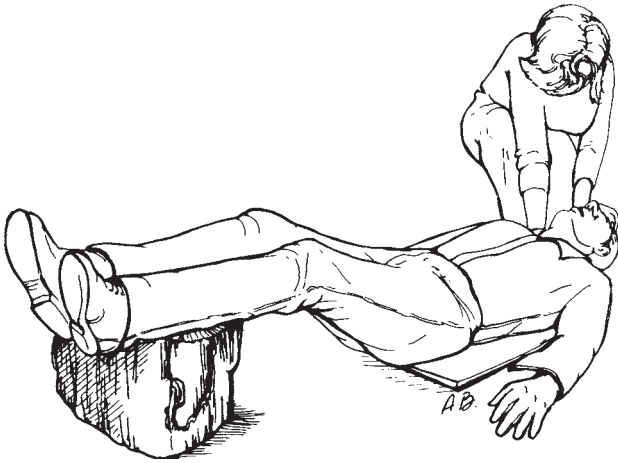


Figure 35. Positioning a victim who is in shock. Elevate the legs, cushion the back, protect the airway, and keep the victim warm.

5. If the victim is diabetic, consider a hypoglycemic reaction (see page 142). If the victim is conscious and can purposefully swallow, administer Glucose paste (see page 142) or a sugar-sweetened liquid by mouth in small sips. Otherwise, do not give the victim anything to eat or drink unless he is alert and thirsty or hungry. If the victim is in shock because of diarrhea and dehydration, attempt to initiate oral fluid intake (see page 208).
6. If the victim has been stung by an insect or appears to be suffering an allergic reaction (see page 66), treat the allergic reaction.
7. Transport the victim to a hospital as rapidly as possible.

HEAD INJURY

Victims of head injury can be divided into two groups, according to whether or not they have lost consciousness. Always be aware that the dazed or unconscious victim cannot protect his airway; you must be vigilant in your observation. The most common complication of head injury is obstruction of the airway with

the tongue, blood, or vomitus. The most common associated serious injury is a broken neck.

LOSS OF CONSCIOUSNESS

If a person struck in the head has lost consciousness, he has suffered at least a concussion. The definition of a concussion is an immediate and temporary loss of consciousness accompanied by a brief period of amnesia after a blow to the head. The following signs and symptoms are commonly associated with a concussion: unaware of what happened; confusion; loss of memory (not typically including, however, one's name and address); loss of consciousness; headache or sensation of pressure in the head; dizziness; balance problems; nausea; vomiting; feeling "foggy," "dazed," or "stunned;" visual problems (e.g., seeing stars or flashing lights, or seeing double); hearing problems (e.g., ringing in the ears); irritability or emotional changes; slowness or fatigue; inability to follow directions or slow to answer questions; easily distracted or poor concentration; inappropriate emotional behavior; glassy-eyed or vacant staring; slurred speech; seizure. With regard to the latter, a single brief seizure immediately following a concussion is not necessarily an ominous sign. Headache, dizziness, and difficulty concentrating may persist for weeks after a concussion, so the victim should not be in a position, such as lead climber, to put others at risk.

1. *Protect the airway (see page 22) and cervical spine (see page 37).*
2. If the victim wakes up after no more than a minute or two and quickly regains his normal mental status and physical abilities, he has probably suffered a minor injury—so long as there is no relapse into unconsciousness or persistent lethargy, nausea or vomiting, or severe headache. If the victim is far from help, he should undertake no vigorous activity and be kept under close observation for at least 24 hours. It is commonly taught that after someone has sustained a head injury with loss of consciousness (implying a concussion), he or she should be kept awake. It is also taught that if the victim falls asleep, he should be awakened regularly, presumably to demonstrate that he can be woken up, and has not worsened or lapsed into a coma. However, be aware that sleeping in and of itself has no influence on the progression of the head injury. Furthermore, some persons who have suffered a concussion (or worse) become sleepy. If they fall asleep, they will not worsen because they fall asleep. If they worsen, it is part of the progression of the head injury, not related in any way to sleep. You cannot keep someone awake forever, because they need sleep in order to rest.

So, if you are in a situation where you are assessing someone who has suffered a head injury to determine their neurologic status, you need to set reasonable intervals at which to perform the examinations. There is no magic number, but if you are concerned that someone is worsening, at least once an hour seems reasonable. Signs of worsening following a

blow to the head include nausea and vomiting, blurred vision, increasing headache, and any change in mental status (e.g., declining alertness, ability to converse, or ability to follow commands; increasing confusion; or decreasing level of consciousness). If someone seems more sleepy than usual after a head injury, particularly if it is a child, perhaps difficult to assess and compounded with exhaustion, it is better to be safe than sorry. Bring that person to medical attention as soon as possible.

3. Confusion or amnesia for the event that caused the blackout is not uncommon and not necessarily serious, so long as the confusion does not persist for more than 30 to 45 minutes. Because a serious brain injury may not become apparent for hours, the wilderness traveler who has been knocked out should not venture farther from civilization for 24 hours. If headache or nausea persists beyond 2 to 3 hours, the victim should begin to make his way (assisted by rescuers) to medical care.

If the injury is minor and evacuation is not undertaken, advance the victim's activity as follows: no activity and complete rest until without symptoms; next, light walking without any heavy lifting or resistance activity; next, mild exercise with slight resistance; finally, full activity. Do not progress beyond one "level" each 24-hour period.

4. If the victim wakes up and is at first completely normal, only to become drowsy or disoriented, or to lapse back into unconsciousness (typically, after 30 to 60 minutes of normal behavior), he should be evacuated and rushed to a hospital. This may indicate bleeding from an artery inside the skull, causing an expanding blood clot (epidural hematoma) that compresses the brain. Frequently, the unconscious victim with an epidural hematoma will be noted to have one pupil significantly larger than the other (Figure 36).
5. If the victim awakens but has a severe headache, bleeding from the ears or nose with no obvious external injury to those organs, clear fluid draining from the ear or nose, unequal-sized or poorly reactive (do not constrict promptly on exposure to bright light) pupils, weakness, bruising behind the ears or under the eyes, vomiting, or persistent drowsiness, he might have a skull fracture. Such signs mandate immediate evacuation to a medical facility.

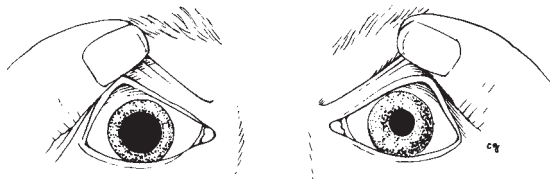


Figure 36. Unequal pupils.

6. If the victim suffers a seizure (see page 68) after a head injury, no matter how brief, he should be transported to a medical facility.
7. If the victim does not wake up promptly after a head injury (unconscious for more than 10 minutes), has bleeding from an ear, has unequal or non-reactive (do not constrict to bright light) pupils, has clear fluid from the nose, has a profound headache, is weak in an arm or leg, is disoriented, or has a fluctuating level of consciousness (normal one minute, drowsy the next), he may have suffered a significant brain injury and should be immediately rushed to a medical facility. Because there is a high incidence of associated neck injuries, any person with a serious head injury should have his cervical spine immobilized (see page 37). Head injuries often cause vomiting. Therefore, be prepared to turn the victim on his side so that he doesn't choke (see page 24).
8. Glasgow Coma Scale (GCS). This scale is used by medical professionals as a guide to the presence of head injury and to follow the progress of a head-injured victim.

Eye Opening	Spontaneous	4
	To voice	3
	To pain	2
	None	1
Best Verbal Response	Oriented	5
	Confused	4
	Inappropriate	3
	Incomprehensible	2
	None	1
Best Motor Response	Obeys commands	6
	Localizes pain	5
	Withdraws from pain	4
	Flexes the limbs	3
	Extends the limbs	2
	None	
Total Score		3 to 15

13 to 14 is mild brain injury

9 to 12 is moderate brain injury

3 to 8 is severe brain injury

Even persons with a GCS score of 15 can deteriorate if they have suffered apparently minor head injuries. Warning signs for persons who might have a serious problem include vomiting, restlessness, observed decrease in GCS score,

severe headache, confusion, and a focal blow to the side of the head. So, if a person appears normal, but has suffered any one of these, he or she is perhaps at a greater risk for having a serious brain injury. This person therefore should be watched very closely. If you are far from medical attention, you should make plans for a prompt evacuation.

NO LOSS OF CONSCIOUSNESS

If a person has been struck on the head but was never knocked out, he will rarely have incurred a serious injury to the brain. The scalp should be inspected for cuts, which generally bleed freely; it may require considerable pressure to stop the bleeding (see below). If the victim seems normal (answers questions appropriately; knows his name, the location, and the date; walks normally; appears coordinated; has normal muscle strength), there is probably no need to perform a hurried evacuation. If the victim is in any way abnormal, however, he should be rapidly transported to a medical facility. A person with minor head injury who displays any of the following should be watched very closely: vomiting, persistent headache, age over 60 years, intoxication with drugs or alcohol, problem(s) with short-term memory, and any physical evidence of injury above the collarbone. A small child who has been struck on the head and begins to vomit, refuses to eat, becomes drowsy, seems apathetic, or generally appears abnormal should be examined by a physician as soon as possible.

LACERATIONS OF THE SCALP

Cuts of the scalp tend to bleed freely, because the blood vessels are positioned in the thick skin in such a way that they cannot go into spasm and seal off after they are severed. For this reason, it is important to apply prolonged firm pressure to any head wound, and to seek care as soon as possible. If possible, any closure method should be preceded by a quick, vigorous rinse of the wound to remove any large pieces of dirt, gravel, or other debris. One way to keep the edges of the wound together is to first lay a long piece of string or dental floss along and beyond the length of the wound. Next, twirl hair on direct opposite sides of the wound to form strands, and then pull these strands toward each other to pull the skin together. Then, use the string to tie the hair strands together (Figure 37). Repeat this process as necessary to account for the entire open length of the wound. If the wound is large and you do not have any string, you may be able to bring the edges together by tying hair taken from opposite sides of the wound, but this is often quite difficult.

For information regarding wound repair and bandaging, see pages 260 and 276.

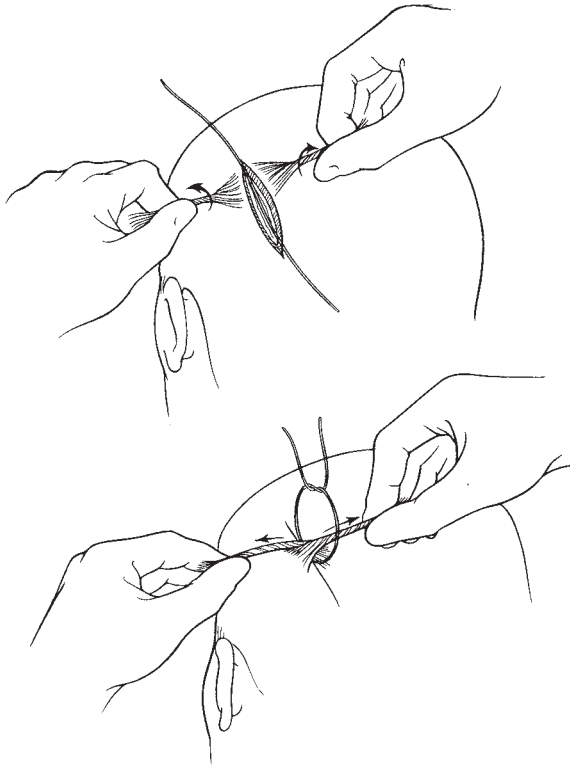


Figure 37. String and hair-tying method for closing a scalp wound.

ALLERGIC REACTION

A severe allergic reaction (anaphylaxis) can be life-threatening. It is caused by exposure to insect and animal venoms (such as wasp or jellyfish stings), plant products, medications, or any other agent to which the victim's immune system has been previously sensitized.

Symptoms include low blood pressure (shock); difficulty breathing (severe asthma) with wheezing; swelling of the lips, tongue, throat, and vocal cords

(leading to airway obstruction); itching; hives (red, raised skin welts that may occur singly or in large patches); nausea and vomiting; diarrhea; abdominal pain; seizures; and abnormal heart rhythms. Any or all of these symptoms may be present in varying severity. The most common life-threatening problem is respiratory distress. Facial swelling indicates that the airway may soon become involved. *Be ready at all times to protect and support the airway.*

TREATMENT FOR AN ALLERGIC REACTION

1. Administer aqueous epinephrine (adrenaline) 1:1,000 in a subcutaneous injection (see page 474). The adult dose is 0.3 to 0.5 mL; the pediatric dose is 0.01 mL/kg of body weight, not to exceed a total dose of 0.3 mL. For weight estimation, 1 kg equals 2.2 lb. The drug is available in preloaded syringes in certain allergy kits, which include the EpiPen autoinjector and EpiPen Jr. autoinjector (Dey), the Twinject autoinjector (Verus: 0.3 mg or 0.15 mg doses; 2 doses per unit), and the Ana-Kit. Instructions for use accompany the kits. The EpiPen and Twinject epinephrine products are generally easier for laypeople to use, because they require less dexterity to accomplish injection with them. The Twinject autoinjector and Ana-Kit syringe are configured with enough epinephrine for a second (repeat) dose, which is sometimes necessary. The Twinject is a true autoinjector for the first dose; the second dose is delivered as a routine injection from a concealed syringe and needle.

For dosing purposes, the EpiPen and Twinject 0.3 mg autoinjector should be used for adults and children over 66 lb (30 kg) in weight. Children 66 lb and under should be injected with the EpiPen Jr. or Twinject 0.15 mg autoinjector. Take particular care to handle preloaded syringes properly, to avoid inadvertent injection into a finger or toe. Do not intentionally inject epinephrine into the buttocks or a vein. Epinephrine should not be exposed to heat or sun, but does not need to be kept refrigerated. If clear (liquid) epinephrine turns brown, it should be discarded. When administering an injection, *never* share needles between people.

2. Administer diphenhydramine (Benadryl) by mouth. This is a histamine-1 receptor antagonist drug. A milder reaction that does not require epinephrine or corticosteroids may be managed with diphenhydramine alone. The adult dose is 50 to 75 mg every 4 to 6 hours; the pediatric dose is 1 mg/kg (2.2 lb) of body weight, also every 4 to 6 hours. The major side effect of this medication is drowsiness. A nonsedating antihistamine suitable for this purpose is fexofenadine (Allegra) 60 mg capsule for adults.
3. In case of a severe reaction, administer corticosteroids. Prednisone tablets in a dose of 50 to 80 mg should be given to an adult; the pediatric dose is 1 mg/kg (2.2 lb) of body weight. The onset of action of steroids is delayed for 4 to 6 hours; therefore, this drug should be given early in the course of therapy.

4. Administer an inhaled (aerosol or “micronized”) bronchodilator. Bronchodilators (airway openers) are drugs that have the advantages of minimal side effects and direct delivery to the site of action. They are available in metered-dose handheld nebulizers (“mistometers”) from which the victim inhales therapeutic puffs. An excellent drug for an acute attack is albuterol (Ventolin). The dose for an adult is two to six puffs initially, followed by two to four puffs every 3 to 6 hours. A child over age 12 who can manage the device may use a handheld nebulizer; younger children often require oral (liquid) medication in the appropriate dose.
5. Administer a histamine-2 receptor antagonist drug. This can be ranitidine (Zantac) 150 or 300 mg for an adult or famotidine (Pepcid) 10 or 20 mg for an adult.
6. Transport the victim for medical evaluation.

Reactions to specific agents (such as bee stings, plant contact, hay fever, etc.) are discussed elsewhere. Consult the index.



SEIZURE

A seizure (“fit”; epilepsy) represents vigorous involuntary muscle activity and altered consciousness associated with abnormal electrical discharges within the brain. It may be caused by a number of underlying disorders, which include structural abnormalities of the brain (scars, birth defects), injury, tumor, infection, bleeding (stroke), uncontrolled hypertension, lack of oxygen, abnormal blood chemistries (calcium, sodium, glucose), and “recreational” drug abuse (including drug or alcohol withdrawal).

Most seizures have been grouped into various classifications, which include the following types:

Partial. This seizure is initiated in a focal, or “restricted,” part of the outermost layer (cortex) of the brain. Consciousness may (complex seizure) or may not (simple seizure) be impaired.

Generalized. This seizure involves the cortex of the brain in a symmetrical and synchronous manner, and may lead to “automatic,” “absent,” or profoundly agitated behavior patterns.

Grand mal ("big illness"). In this type of generalized seizure disorder, the victim classically becomes unconscious and has violent repetitive muscle activity with tongue biting, grunting, eye deviation to one side, difficulty breathing, and occasional loss of bladder or bowel control. Following the seizure, the victim will be confused or combative for a time (10 to 60 minutes) as he slowly returns to normal. He may sleep for a while after a seizure.

Status epilepticus. This is defined as prolongation of the seizure activity for a period that exceeds 1 to 2 minutes, or as multiple seizures without a return of normal consciousness between fits. Status epilepticus is a true medical emergency.

Petit mal ("little illness"). This is an "absence" attack generally seen in a child; in it, he seems to be daydreaming, distracted, or confused. It is not associated with violent, abnormal physical behavior.

Psychomotor (temporal lobe). This is an episode of patterned abnormal behavior, such as lip smacking, olfactory hallucinations, vulgar speech, or repetitive movements such as arm waving. The origin of the electrical activity is thought to reside in the temporal lobe of the brain.

TREATMENT FOR SEIZURE

1. Protect the airway (see page 22). If the victim vomits, do your best to clear the mouth and nose of debris. Turn the victim on his side. He may suddenly bite down and hold his teeth clenched, so take care not to get your fingers caught in the mouth. A padded object that cannot be bitten through (such as a leather wallet edge) may be used as a bite block to keep the teeth apart and prevent tongue biting, but take extreme care not to obstruct the airway. Do not place a hard object in the mouth that might break the teeth. Take care not to force the tongue backward into the throat. *Never try to pour liquids into the mouth of a seizing victim.*
2. Protect the cervical spine (see page 37).
3. Protect the victim from injuring himself during the seizure. This may be done with cushions, a sleeping bag, or constant repositioning of the victim. If he needs to be physically restrained, keep him on his side. Loosen all clothing around the neck.
4. In most cases, a grand mal seizure will only last 30 seconds to 2 minutes and will be self-limited. The victim will be confused for a few minutes to an hour after the seizure, and should be watched closely for recurrence or difficulty in breathing. If the victim continues to seize or does not wake up between seizures (status epilepticus), he must be transported to a medical facility as soon as possible for drug administration. Any victim who does not fully awaken, who awakens but has never previously had a seizure, or who appears weak or feverish after a seizure should be rapidly evacuated.
5. When the victim awakens, determine if he has ever had a seizure before and whether he is supposed to be taking anticonvulsants. The most common

cause of a seizure is failure to take prescribed antiseizure medication(s). If the victim has been delinquent, he should take his medicine as soon as possible. For an adult, common medications are phenytoin sodium (Dilantin) 300 to 400 mg per day, phenobarbital 30 to 60 mg three times a day, or diazepam (Valium) 5 to 10 mg three to four times a day. Never administer an oral medication to anyone unless he is awake and capable of purposeful swallowing.

6. A possible cause of unconsciousness or seizure in a person who suffers from diabetes is low blood sugar (hypoglycemia). If a diabetic suffers a seizure, he should be given sugar as soon as possible. This may be difficult to do away from the hospital, because intravenous injection will be required if the victim cannot swallow. If a diabetic feels weak, sweaty, dizzy, or nauseated, he should immediately ingest a sugar-containing beverage, food (see page 142), or concentrated liquid glucose (Glutose: one tube contains 25 g). If the victim is unconscious, sugar granules or small squirts of Glutose can be placed under the tongue, where they can be passively swallowed.



FRACTURES AND DISLOCATIONS

A bone fracture (break) may be simple (one clean break) or comminuted (multiple breaks or shattered) (Figure 38). Furthermore, it may be closed (skin intact) or open (“compound,” with the skin broken, often with the bone visible in the wound). An open fracture is highly prone to infection. A fracture may be associated with injuries to adjacent nerves and blood vessels.

A broken bone or dislocation (displacement of a bone at the joint) should be suspected whenever there has been sufficient force to cause such an injury, if a snap or crack was heard, if the victim cannot move or bear weight on the body part, or if an injured body part is painful, swollen, discolored, or deformed. A broken or dislocated bone should be compared with the normal opposite limb; asymmetry is a key sign of a significant injury. Pain with a broken bone tends to be instantaneous, constant, and worsened considerably with motion, which may also create a grating sensation and noise. A small child with a fracture or dislocation will not use the affected body part and will cry vigorously with the slightest

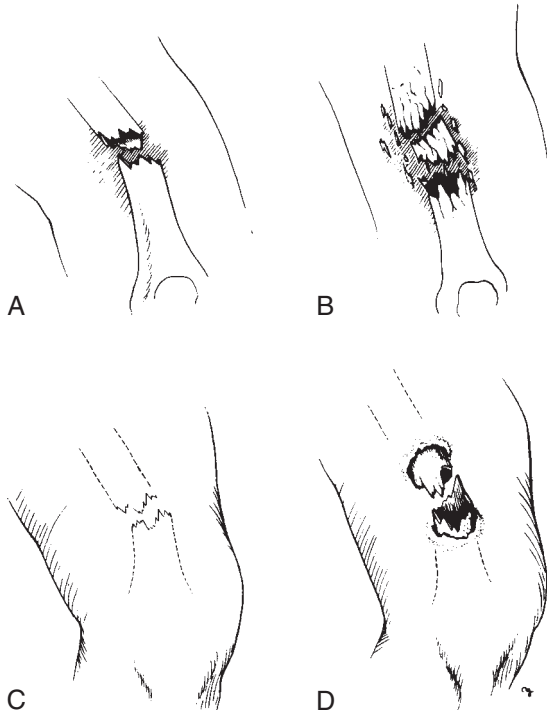


Figure 38. Fractured bones. **A**, Simple fracture (one break). **B**, Comminuted fracture (multiple breaks). **C**, Closed fracture (skin unbroken). **D**, Open, or compound, fracture (skin broken).

manipulation. If you think that a bone may be broken, it is best to treat it as a break until an x-ray can be obtained or the situation shows obvious marked improvement (which usually requires 4 to 6 days).

Because of the force necessary to break or displace a bone, any person with a fracture or dislocation should be examined carefully for other injuries. All fractures and some dislocations cause a certain amount of bleeding, which can be significant with the larger bones (femur, pelvis). For instance, it is possible to lose 250 to 500 mL of blood at the site of a humerus fracture, 350 to 650 mL from a tibia fracture, and 800 to 1,200 mL from a femur fracture. Be prepared to treat the victim for shock (see page 60). Do not manipulate a broken limb unnecessarily, even if circulation to the limb seems normal; excess motion increases the risk of damage to the bones, nerves, and blood vessels. When examining an injury, always begin with an uninjured area and work toward the injury, so that the victim's response to pain doesn't interfere with your exam.

If the skin has been disrupted in the vicinity of the broken bone, the fracture is open. The bone end may or may not be visible through the wound, and

bleeding may be minor or major. If a victim has sustained an open fracture, is alert enough to swallow liquids, and is more than 6 hours distant from a medical facility, administer penicillin, erythromycin, amoxicillin, or cephalexin 500 mg by mouth every 4 hours. Rinse the wound gently to remove any obvious dirt, and then cover it with a sterile dressing. Do not vigorously scrub or irrigate the wound. Unless there are signs of loss of circulation (coldness, blue color or paleness, numbness) or it is necessary to realign the limb to allow splinting and evacuation, do not try to reposition the injury or to push the bone back under the skin. If you must manipulate the limb, rinse any visible bone with water or disinfectant (such as povidone iodine 10% solution), and then allow the bone to slide under the skin without touching it. While holding traction (pulling on the end portion of a limb in a longitudinal axis to achieve correct anatomic alignment), immediately apply a splint (see page 74) to prevent further motion and damage.

In general, it is unwise to manipulate an injured limb. If the extremity is deformed, but the circulation is intact (normal pulses, sensation, temperature, and color), do not attempt to straighten it; instead, splint it in the position in which you found it ("splint 'em as they lie"). On the other hand, if the circulation to an extremity is obviously absent (the extremity is numb, cold, and blue or pale), if the victim is in extreme discomfort, or if gross deformity prevents moving the victim out of a dangerous situation or prevents the application of a splint, then an attempt to restore the part to a normal position is justified. Early realignment is easier than delayed realignment, may alleviate a major amount of pain, helps control blood loss into the surrounding soft tissues, may decrease the incidence of fat emboli (fat from the bone marrow entering the bloodstream and causing severe illness), and often allows easier splinting and transport. Be advised, however, that the relocation of a fracture or dislocation may be difficult and transiently very painful for the victim. If you are going to make an attempt to realign a limb, it should be done as soon as possible after the injury (preferably, within 3 hours), before swelling and increasing pain and muscle spasm make the maneuver impossible. If there is no deformity, splint the injured body part in the "position of function" (the position it would assume if it were at rest) (Figure 39).

To attempt to reposition a displaced body part, apply steadily increasing traction (pulling force) to the injury while applying countertraction above the injury. Do not forcefully lever or snap a bone back into position with a quick, forceful motion. To gain mobility in a deformed area, it is sometimes necessary to gently rock the body parts or slightly accentuate the deformity ("distract" the joint to create maneuvering space between the bones) while applying continuous traction away from the body. This allows the dislocated part to clear any obstruction and slip back into position. If the part is repositioned, it should be held in place while you splint it into position. After such maneuvers, check to see that circulation has been restored. *In no circumstance should you try to reposition a suspected cervical spine injury.*

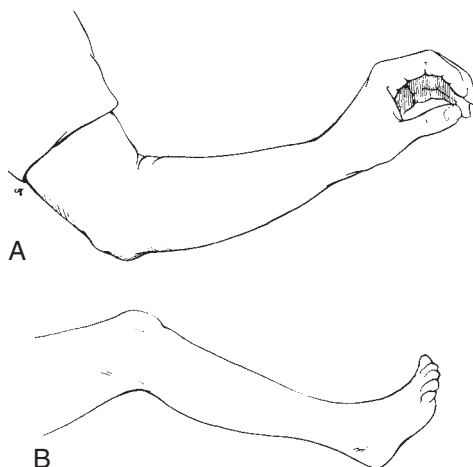


Figure 39. Position of function (normal anatomic resting position). Unless otherwise specified, the upper and lower limbs should be bandaged or splinted in these positions. **A**, Upper extremity. **B**, Lower extremity.

COMPARTMENT SYNDROME

Within the limbs (legs, arms, forearms, feet, hands, and fingers), there are “compartments” defined by inelastic boundaries of tough connective tissue, or fascia. These compartments contain bones, groups of muscles, blood vessels, and nerves. If swelling occurs within a compartment—typically caused by bleeding, continuous excessive external pressure, or a crush injury—the pressure can exceed 30 mm of mercury, which is the pressure at which blood travels through microscopic blood vessels, such as capillaries. This effectively squeezes the tiniest blood vessels and occludes flow through them, cutting off circulation to the compartment and rapidly causing tissue death. The most common cause of compartment syndrome in a wilderness enthusiast is swelling surrounding a broken bone or associated with a severe blunt injury, such as occurs after a fall. The lower leg and forearm are the most common sites. Compartment syndrome is rare following snakebite (see page 346), because most of the swelling following a bite is confined to superficial soft tissues.

Signs and symptoms include severe pain that seems out of proportion to the injury. The underlying tissue feels extremely tight, and pain is increased markedly with external pressure. Stretching the muscles that run through the compartment causes worsened pain. There may be decreased sensation or tingling in those skin areas supplied by the nerves that run through the compartment—for example, decreased sensation to pinprick or light touch on the top of the foot in the web space between the great and second toes because of pressure on the deep peroneal nerve, which runs through the anterior leg compartment. The

limb may become pale or show a bluish tinge. When pulses become diminished or lost, the situation has become severe, and the limb will be weak or become useless (paralyzed).

Field treatment involves elevation of the affected limb, splinting, padding to protect against further injury, and rapid evacuation. A true compartment syndrome must be treated with surgery to open the compartment and allow the pressure to be reduced. Severe damage can occur within 6 hours of the onset of the syndrome. Do not administer aspirin to the victim. Cold packs are of limited, if any, benefit; never immerse a limb in ice water.

SPLINTS AND SLINGS

A splint should be applied to any broken bone, bad sprain, or severely lacerated body part after gross deformity is corrected, to maintain proper position and immobilize the injured part (or parts) so that it cannot be displaced. This prevents further nerve, blood vessel, and muscle damage, and keeps broken bone ends from grating against each other or from poking through the skin. A sling-and-swathe combination helps to further immobilize a limb. Pain may be lessened or relieved by eliminating unnecessary motion, allowing more rapid transport.

These general guidelines should be followed in the application of splints:

1. Examine every suspected fracture to see if it is open or closed (see page 70). Check the circulation below the fracture site by inspecting pulses, skin color, sensation, and movement of fingers and toes. In the arm, check the radial and brachial pulses; in the leg, check the popliteal, dorsalis pedis, and posterior tibial pulses (see Figure 16).
2. Control bleeding (see page 54) and apply a dressing if necessary.
3. Splint the joint above and below the injury. For instance, to keep the knee from moving, you often need to prevent motion at the ankle, knee, and hip. There will be times when this is difficult, but do the best you can.
4. If possible, fashion the splint first on an uninjured body part, and then transfer it to the injured area. This lessens manipulation of the injured part and minimizes pain associated with splinting.
5. Splints can be fashioned from sticks, cardboard, foam pads, rolled newspapers, pack frames, ski poles, or other similar objects (Figure 40). The SAM Splint has become a standard item for the outdoor first aid kit. The core of the SAM Splint is a long rectangle of “O” temper, ultrathin aluminum alloy. The covering layers are made of dermatologically safe closed-pore foam. The splint is available in a standard size of 4¼ in by 36 in, which rolls easily to become a 3 in by 4¼ in cylinder. It can be shaped to splint a great number of body parts. The splints also comes in a 5½ in wide XL version, in prepackaged lengths of 18 inches and 9 inches, and as a finger splint that measures 3.75 by 1.75 in.

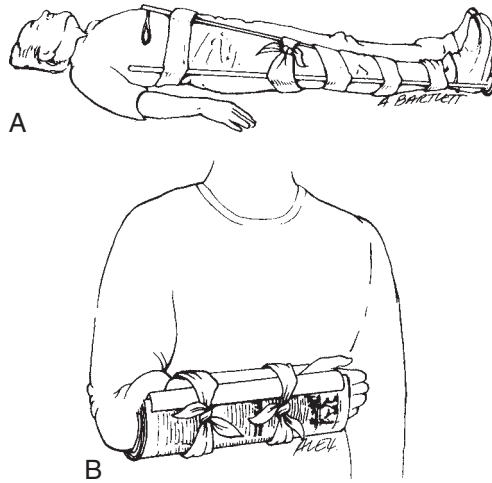


Figure 40. Splints may be fashioned from items such as **(A)** ski poles and **(B)** rolled newspaper.

Foldable or rollable wire splints can be constructed by cutting 6 in by 30 in (15 cm by 76 cm) and 18 in by 36 in (46 cm by 91 cm) pieces of $\frac{1}{8}$ in or $\frac{1}{4}$ in (3 mm or 6 mm) wire mesh and covering the sharp edges with adhesive or duct tape.

An inflatable air splint is sometimes less desirable, in that it can only attain one shape and may create circulation problems by exerting too much pressure on injured tissues. If you use an air splint, be sure that it has a mechanism to adjust for volume expansion (heat and altitude). When stored at freezing temperatures, it should be kept partially inflated so that any frozen moisture (from inflating breaths) within the air bladder doesn't cause the walls to adhere.

Fasteners can include belts, triangular bandages, tape, elastic wraps, shirtsleeves, and blankets. Slings can be fashioned from triangular bandages, cravats, sheets, ropes, and vines.

6. When applying a splint, don't cut off the circulation. Pad all bony prominences, other pressure points, and injuries as best as possible. This may be done with foam, a sleeping pad, pack material, or clothing.
7. If the injury is closed (skin unbroken) and there are no signs of decreased circulation, apply ice packs intermittently to the swollen area. Do not apply ice directly to the skin.
8. Remove all constrictive jewelry (watches, bracelets, rings, and so forth). Left in place, these can become inadvertent tourniquets on swollen limbs and fingers (see page 477).
9. Administer appropriate pain medication.

10. After a splint is applied, check the limb periodically to make certain that swelling inside the splint has not cut off the circulation. This is particularly important in cold weather, where numbness can be a confusing factor.
11. Elevate the injured part as much as possible, to minimize swelling.
12. Insist that all victims seek medical evaluation when they return home, to be certain that all bones are properly aligned and that no further intervention is needed.

To learn more about specific splints and slings, read about the specific injuries (below).

SPECIFIC INJURIES

The major bones of the skeleton are illustrated in Figure 41.

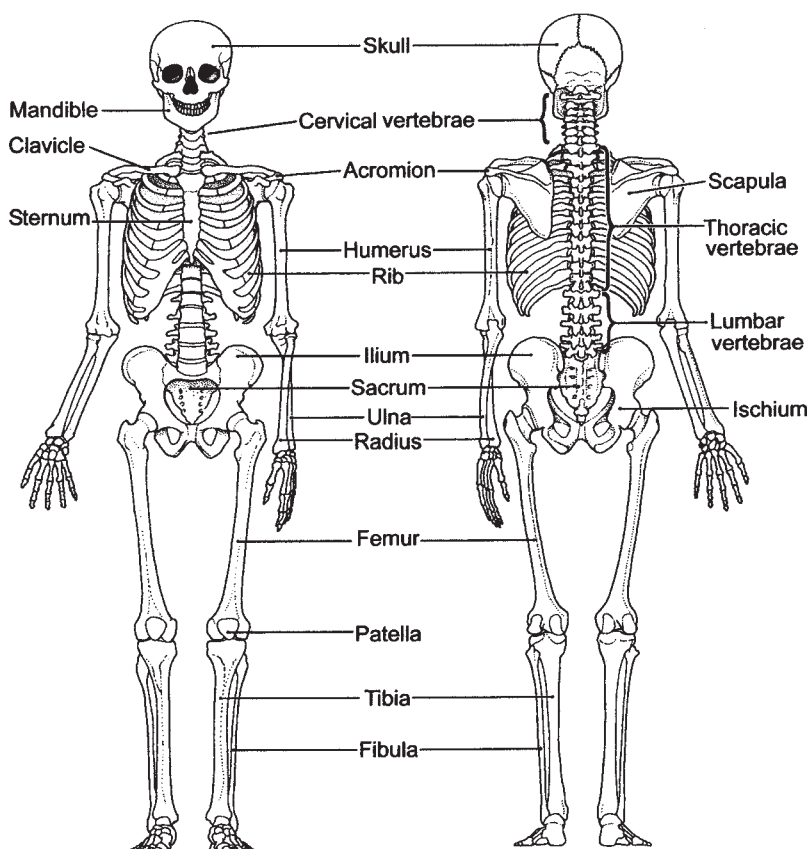


Figure 41. Major bones of the skeleton.

Neck

If a fracture of the cervical spine is suspected because of neck pain, weakness or loss of feeling in an arm or leg, tingling in an arm or leg, or mechanism of injury (for instance, a victim who has fallen, is unconscious, and has a face or head injury), you must immediately immobilize the head and neck. This can be done by taping the head to a backboard or stretcher, by applying a rigid collar (which may be fashioned from a SAM Splint, as in Figure 22), or by placing sandbags or their equivalent on either side of the head (see Figure 21). *Never move the neck to reposition it.*

For the ambulatory, cooperative victim with minor neck discomfort, a thick pad (rolled towel, jacket) can be placed posteriorly at the base of the neck. Secure this by wrapping tape or cloth around the forehead, and then cross it over the pad and bring it back out under the armpits to be tied across the chest (see Figure 23). Alternatively, use a thick removable waistband from a backpack or a rolled Ensolite pad in a horse-collar configuration. Soft-collar techniques should not be relied on to hold the neck immobile; they merely offer gentle support.

If the victim is uncooperative or agitated, hold his head until you can firmly immobilize it and restrain the victim from motion (see Figure 24). All of this is necessary to avoid injury to the spinal cord. If the victim must be moved or turned on his side (most commonly to allow vomiting or to place insulation beneath him), hold his head fixed between your forearms while you hold his shoulders with your hands. In this way the victim can be “logrolled,” using as many rescuers as possible to avoid unnecessary head, neck, and spine motion.

Logrolling the Victim (see Figure 25)

1. The first rescuer approaches the victim from the head, and keeps the head and shoulders in a fixed position so that the neck doesn't move.
2. The second rescuer extends the victim's arm (on the side over which the victim is to be rolled) above the victim's head. The first rescuer uses this arm to help hold the victim's head in proper position.
3. All rescuers work together to roll the victim without moving the neck.

In no circumstance should you try to reposition a suspected cervical spine injury. An alert victim with a broken neck or severely torn ligament will usually have enough discomfort from the injury and muscle spasm to force him to hold his neck still. However, someone with a head injury or who is under the influence of alcohol or drugs may feel no pain, and can have an undetected serious injury that will be worsened by motion.

Any victim with a suspected neck fracture should be transported on a firm board or in a scoop stretcher, if possible.

Skull and Face

See page 61. If there is a fracture of the skull, the victim may demonstrate black eyes (“racoon eyes”), bruising behind the ears (“Battle’s sign”), or cerebrospinal (clear or watery blood-tinged) fluid leaking from the nose or ears. If there are fractures of bones in the face, there will usually be swelling and pain of the overlying soft tissues. If the swelling is severe around the nose, breathing may be impaired. If the bones around the eye socket are broken, there may be double vision or inability of the affected eye (or eyes) to traverse its full range of motion.

Nose

See page 194.

Jaw

A fractured jaw is usually caused by a fall or a blow from a closed fist. The lower bone (mandible) may be broken in one or more places. The victim will complain of pain, swelling, inability to close his mouth, improper fit of the teeth, perhaps missing or broken teeth, and difficulty talking. If the fracture extends into the oral cavity, there may be bleeding from the mouth. Treatment is to wrap a bandage over the top of the head and under the jaw for support (Figure 42). *It should be easily removable in case the victim needs to vomit.* A liquid diet should be maintained until the victim can reach the hospital.

A dislocated jaw can occur from a blow, from a widemouthed yawn, or even during sleep. The mandible slips loose from its two bony sockets below the ears and slides forward (Figure 43). To reposition the mandible, grasp the jaw

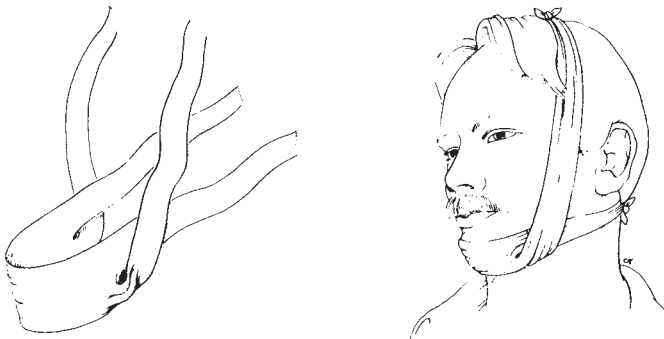


Figure 42. Bandage for a fractured or dislocated jaw. The bandage must be easy to remove, in case the victim needs to vomit.

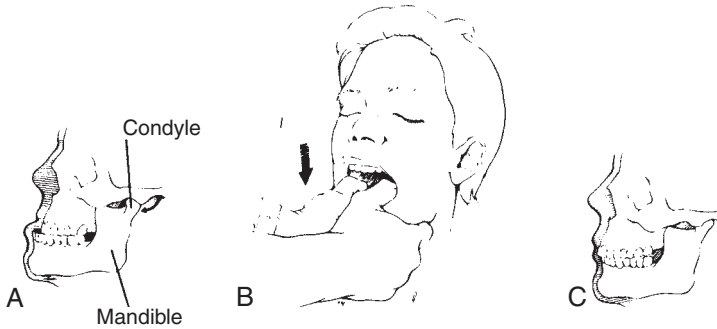


Figure 43. Dislocated jaw. **A**, The condyle of the mandible slips forward out of the joint. The teeth do not fit together properly. **B**, The rescuer applies firm downward pressure to relocate the jaw. **C**, Normal position is restored, and the teeth fit properly.

by placing your thumbs (with cloth or gauze padding for traction) inside the mouth against the lower molars (rear teeth), holding the bone firmly with your remaining fingers. Exert steady pressure straight down until you feel the mandible “pop” back into place, and the victim says his teeth fit properly (Figure 43, B). After the jaw is repositioned, tie a bandage under the chin and over the top of the head to keep the jaw from easily dislocating again (see Figure 42). *The bandage should be easily removable in case the victim needs to vomit.*

Wrist, Hand, and Finger

A fracture or dislocation of the hand, wrist, or finger should be positioned and splinted in the normal resting position (position of function; see Figure 39, A). For a wrist or hand injury, this may be accomplished by allowing the victim's fingers to rest around a padded object in his palm (such as a rolled pair of socks, rolled elastic bandage, or wadded cloth; Figure 44), with a circumferential wrap to maintain position (Figure 45). Every attempt should be made to allow the fingertips to remain uncovered, to assess circulation. If the wrist is involved, place a rigid splint on the underside of the hand, wrist, and forearm to prevent motion (Figure 46). Fingers may be splinted independently or taped together (with padding in between) for support (Figures 47 and 48).

A sling can be applied to the forearm for support and pain relief. A swathe may be added for further immobilization. To make a classic arm sling out of a triangular bandage, lay the bandage under the arm as shown in Figure 49. Tie two corners together with a square knot at the opposite shoulder—which creates the arm cradle—and then pin the remaining elbow corner up onto the body of the sling. A rolled or folded triangular bandage becomes a cravat (see page 277), which is wrapped around the sling-encased arm and chest (as a swathe) to hold

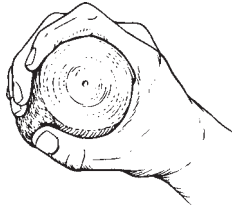


Figure 44. A rolled elastic bandage is gripped gently to maintain the hand in the “position of function.”

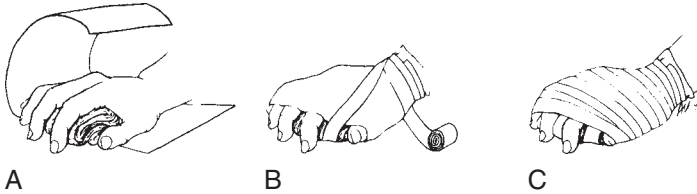


Figure 45. Hand dressing in the “position of function.” **A**, The fingers hold a pad of cloth in the palm. **B**, A circumferential wrap is applied, taking care to pad between the fingers. **C**, The completed wrap leaves the fingertips exposed, so that they can be checked for adequate circulation.

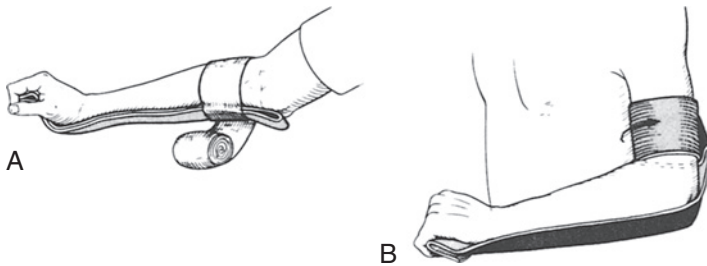


Figure 46. A SAM Splint fashioned to stabilize the wrist and forearm. **A**, In this method, the elbow is free to bend. **B**, The splint can be extended to immobilize the elbow.

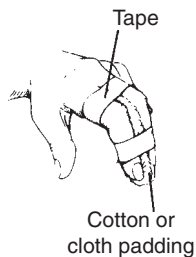


Figure 47. Buddy-taping method to immobilize a finger.

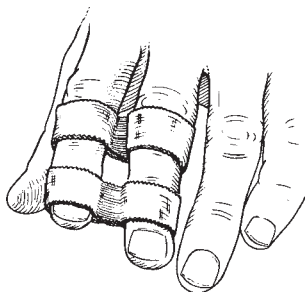


Figure 48. A variation of the buddy-taping method to immobilize a finger. If the fingers are taped together tightly, cotton or cloth should be placed between them for padding.

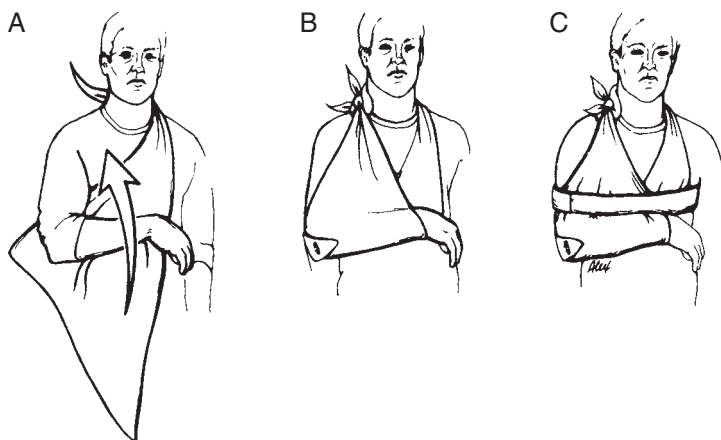


Figure 49. Sling and swathe. **A**, A triangular bandage is draped under the arm and over the opposite shoulder. **B**, Two corners are tied behind the neck, and the third is pinned at the elbow. **C**, A cravat swathe holds the arm against the chest.

the arm snug against the body wall (see Figure 49, C). If materials to fashion a sling are not available, the victim's shirt can be pulled up and pinned to create a crude hammock for the arm (Figure 50), or you can pin the shirt sleeve to the body of the shirt after the elbow is flexed to the proper position (Figure 51).

If a finger is dislocated at the middle or distal joint (Figure 52, A), make a gentle attempt at relocation by applying steady, firm traction to the fingertip (Figure 52, B). Do not try to reposition the joint with a sudden forceful snap. It is often easiest to relocate a finger if you hold the joint slightly bent and push the distal (overriding) bone back into position with your thumb(s) while you are pulling the bones back into their proper position. It is nearly impossible to reduce a dislocation at the knuckle of the index finger without an operation. After a finger

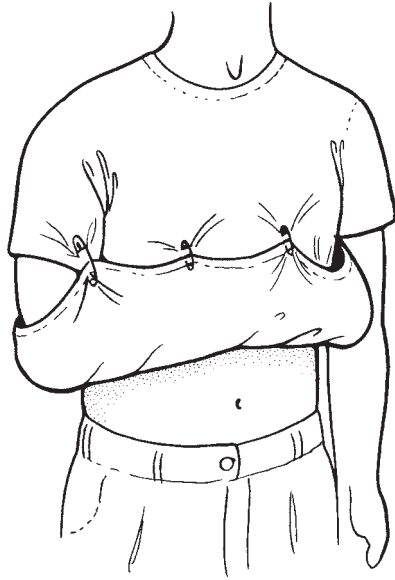


Figure 50. Pinning the shirt to make a hammock sling for the arm.

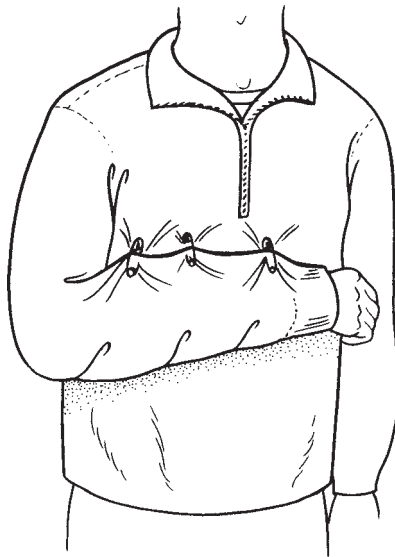


Figure 51. Pinning a shirt sleeve to the chest.

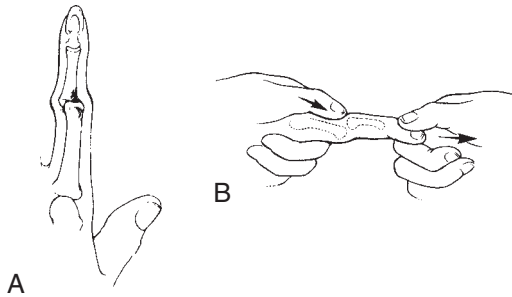


Figure 52. **A**, Dislocation of a finger joint. **B**, Relocation of the bones with firm, steady traction.

is realigned, it should be taped to one or two adjacent fingers for splinting (see Figures 47 and 48).

A “mallet finger” (Figure 53, A) results from disruption of the extensor tendon, which normally pulls the tip of the finger into a straight position. The finger should be splinted with a slight amount of hyperextension (Figure 53, B).

If the thumb is dislocated or fractured, it can be taped to prevent further injury, by fixing it with an anchor to the index finger (Figure 54, A) or directly against the hand (Figure 54, B). You can use the anchor technique to hold any two fingers together.

Forearm

A fracture of the forearm should be splinted to immobilize the wrist and bent elbow (see Figure 46, B). This may also be done in a “sugar tong” fashion (Figure 55). Fashion a sling and attach it to the trunk with a swathe (see Figure 49).

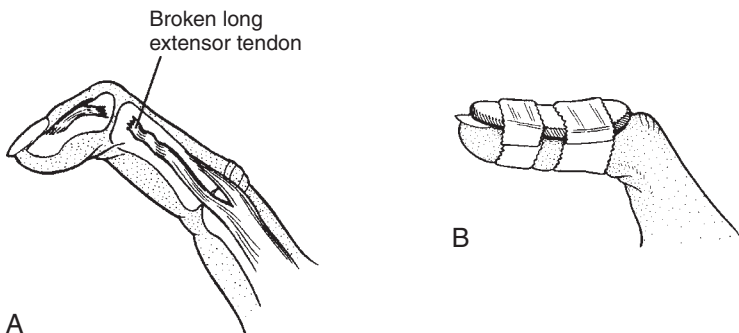


Figure 53. **A**, Mallet finger. **B**, Splinting a mallet finger.

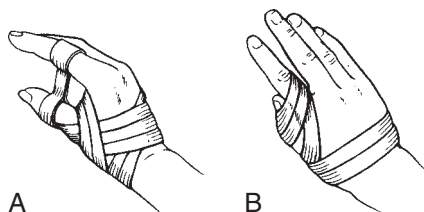


Figure 54. Taping the thumb for immobilization. **A**, The buddy-taping method. **B**, A thumb-lock. If possible, padding should be placed between the thumb and the forefinger.

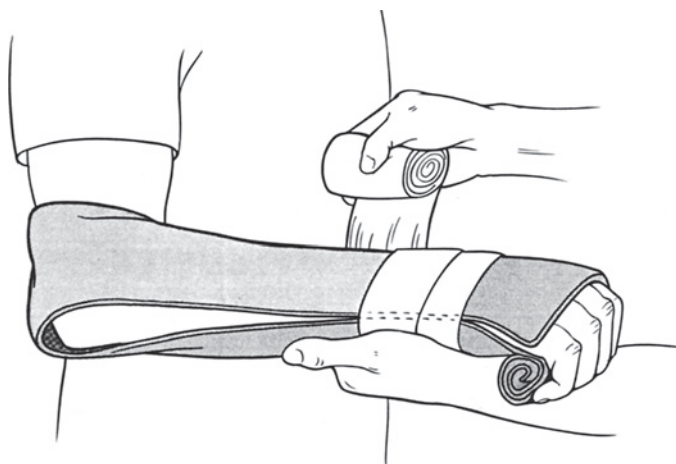


Figure 55. SAM Splint used to splint the wrist and elbow.

Elbow

A fracture of the elbow should be splinted to include the wrist and shoulder, if possible, and at an angle of 60 to 90 degrees. However, if it is painful for the victim to move his elbow, splint it in the position in which you found it. A sling should be fashioned and attached to the trunk with a swathe. A dislocated elbow should be realigned if necessary to restore circulation to the hand. Hold the arm bent 45 to 90 degrees at the elbow and use a lever motion to pull the bones of the forearm back into position, while holding the upper arm fixed in countertraction (Figure 56). This may require a fair amount of force to accomplish and is usually difficult if the victim cannot relax.

“Nursemaid’s Elbow.” The radius and ulna are the long bones of the forearm, and join with the humerus (the long bone of the upper arm) at the elbow joint. In young children, if a sudden straight pulling force is applied to the arm, such as when a child’s hand is tugged to pull him along, or he is swung in a



Figure 56. Repositioning a dislocated elbow.

circle vigorously by the arms, the ligament that holds the radius in place may slip off the head of the radius within the elbow. There may be an audible snapping sound and immediate pain, but the pain may subside rapidly, after which the child will not use the arm. If this occurs and you are close to medical care, splint the arm as for a fracture. However, if you are far from care and wish to see if you can remedy the situation (that is, return the ligament to its proper position), take the child's arm and do the following. First, bend the elbow to 90 degrees and rotate the hand and forearm such that the thumb moves away from the body (accentuated hitchhiker's gesture) (Figure 57). If no "pop" is felt or heard, keep the thumb pointed away from the body and move the forearm toward the upper arm (that is, "flex" the arm) until you have moved it as far as you can (Figure 58). If the ligament moves back to its proper position, the child will begin to use his arm again within 10 minutes. After that, there is no need for a sling or splint. If the child still will not use his arm, seek medical attention.

Upper Arm

The entire length of the bone of the upper arm (humerus) can be palpated for tenderness or deformity from the arm's inner aspect. A fracture of the humerus can be differentiated from a dislocated shoulder by observing how the victim holds his arm. With a humeral fracture, the arm is often held close to the chest, whereas a dislocation of the head of the humerus from the shoulder socket (shoulder dislocation—see page 89) prevents the victim from pulling his arm into his body.

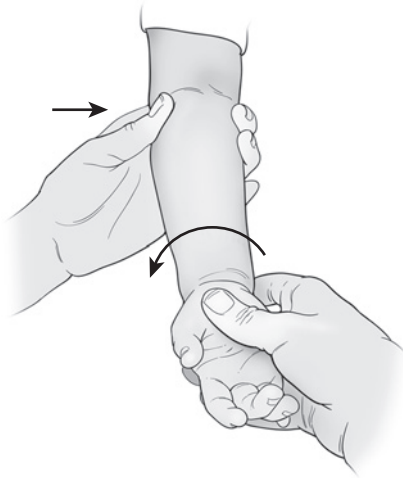


Figure 57. To reduce a nursemaid's elbow, rotate the hand and forearm as shown, and then flex the forearm toward the shoulder.

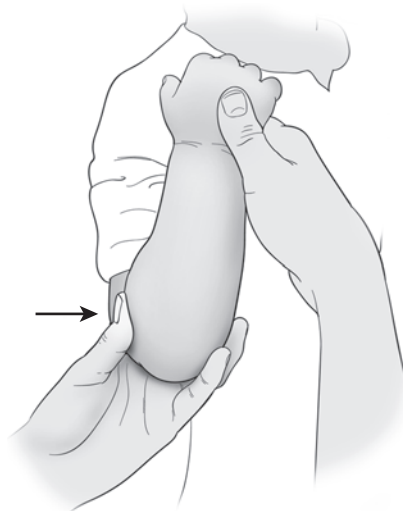


Figure 58. If no pop is felt after rotating the elbow and flexing the forearm toward the shoulder, maintain the rotation and flexion and push the hand more firmly toward the upper arm.

A fracture of the upper arm, particularly if it is close to the shoulder, is often quite difficult to splint. A “sugar tong” splint can be fashioned using a SAM Splint, by laying the splint along the inner and outer surfaces of the arm, with the U of the “tong” at the elbow (Figure 59). If possible, the elbow should be kept bent at 90 degrees and the arm placed in a sling. Attach the sling to the body by using a

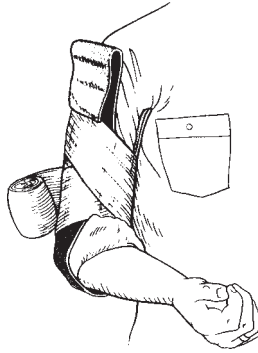


Figure 59. The SAM Splint can be conformed in a “sugar tong” to immobilize the upper arm.

circumferential (around the chest) swathe fashioned from a belt, rope, or long piece of cloth to prevent motion of the arm at the shoulder (see Figure 49).

Two padded board splints can be used to stabilize an arm fracture above the elbow (Figure 60). The splints cross the upper part of the arm and the midforearm to create a triangle with the elbow. A sling is added for support.

Collarbone

A fracture of the collarbone is best managed with a sling and swathe (see Figure 49) or a modified figure-of-eight bandage (or both). The latter is created by draping a rope, cloth, or cravat behind the neck across the shoulders, then forward over the shoulders and under the arms (pad the armpits, if possible), to be tied in



Figure 60. Padded boards to splint the upper arm.

the back (Figure 61). This will pull the shoulders back into the military position. To provide a tighter fit, tie the cross-shoulder section to the lower knot (giving a figure-of-eight appearance). After the figure-of-eight bandage is pulled snug, the affected arm may be fixed to the chest using a sling and swathe. Another technique is to weave a figure-of-eight bandage with a long, rolled elastic bandage (Figure 62). If any figure-of-eight bandage increases the victim's discomfort, you can use a sling and swathe alone. A collarbone fracture appears to heal equally well with either technique, so the major issue is immobilization for comfort.

Another alternative is to have the victim wear a properly fitted backpack with shoulder straps and carry approximately 15 pounds of weight in the pack.

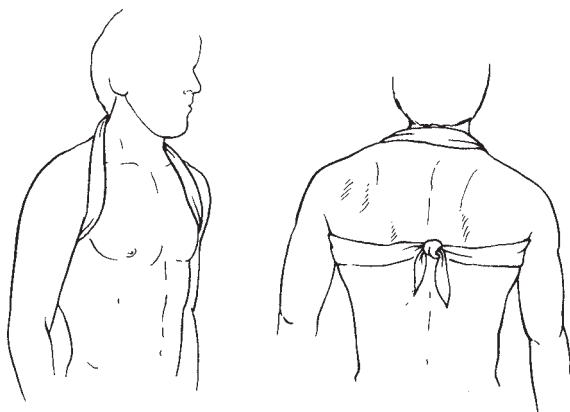


Figure 61. Modified figure-of-eight bandage for a broken collarbone.

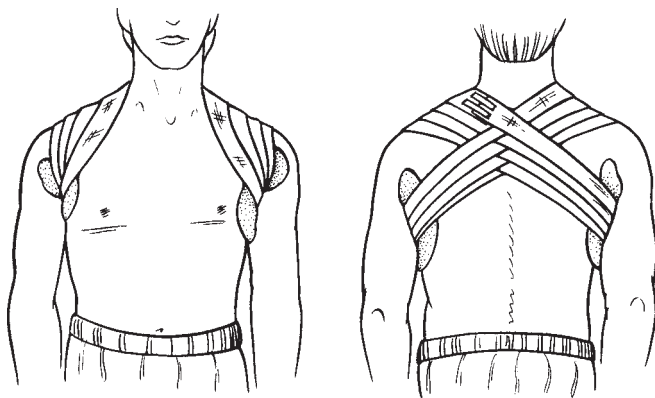


Figure 62. Woven figure-of-eight bandage for a broken collarbone.

Shoulder Dislocation

The long bone (humerus) of the upper arm fits into the shoulder joint with a ball-and-socket mechanism, held in place by muscles and tendons (Figure 63, A). When a person falls onto his shoulder or an outstretched arm, or has his arm twisted or pulled forcefully, the head of the humerus can dislocate out of the shoulder joint (Figure 63, B). This is usually quite painful and may be associated with a fracture of the humerus or the lip of the shoulder socket. The diagnosis of shoulder dislocation is made by observing and feeling a depression in the shoulder where the upper arm bone should be (see Figure 63, B), noting that the victim holds the arm up and away from the body (Figure 64), and feeling the head of the humerus as a firm ball 2 to 3 in (5 to 7.5 cm) below its normal location. There is reduced range of motion of the joint and absence of a “grating sensation” (indicating absence of a broken bone). Those who have previously suffered shoulder dislocations are often prone to recurrent episodes with lesser forces applied to the joint.

If the injured victim can be transported to a medical facility within 3 hours, there is no need to attempt relocation of the arm unless he is in extreme pain. Place the arm in a sling, position some padding underneath the arm and against the chest, and secure the sling to the victim's chest with a swathe to minimize motion and discomfort (see Figure 49).

If more than 3 hours will elapse before medical help is obtained, if the dislocation is recurrent (has happened to the same shoulder before), or if the victim is suffering intolerable pain, you can make an attempt to reposition the arm bone in its socket. Do not attempt relocation if the upper arm or elbow is deformed

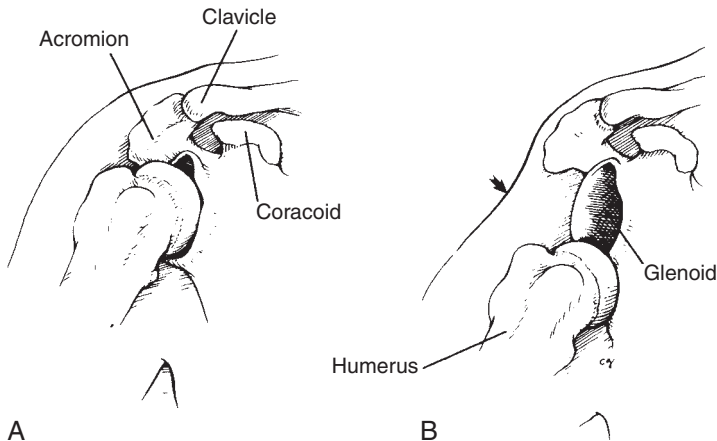


Figure 63. Dislocated shoulder. **A**, Normal anatomy. **B**, With dislocation, the head of the humerus slips out of the glenoid (socket), and a depression (arrow) is noted in the external appearance of the shoulder.



Figure 64. The victim with a dislocated shoulder carries the arm up and away from the body.

(indicating a broken bone). The safest and simplest technique for relocation is to pull with steady, forceful traction on the injured arm, directed at a 45- to 90-degree angle away from the body. At the same time, someone should provide countertraction by holding a sheet or blanket that is wrapped across the victim's chest and under the affected armpit (Figure 65). The easiest technique is to tie a sheet, belt, webbed strapping, or avalanche cord around the rescuer's waist and the victim's bent forearm, so that the rescuer (standing or kneeling) can lean back to apply traction, keeping his hands free to guide the head of the humerus back into position (Figure 66). In all cases, place padding in the armpit and bend of the elbow to prevent a pressure injury to sensitive nerves beneath the skin. A single rescuer can provide countertraction by placing his foot against the victim's chest just below the armpit, or fixing the countertraction sheet or rope to a tree or ice ax buried in the ground; he can also use a life jacket as a foot brace (Figure 67). *Do not jerk the arm, attempt to twist or lever it into position, or pull with a tugging motion.*

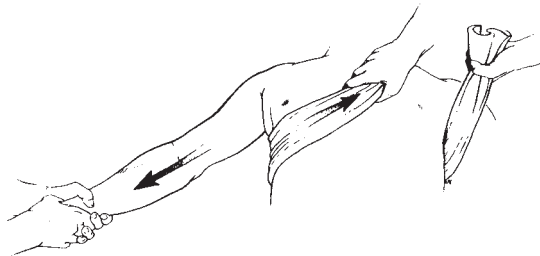


Figure 65. Technique for relocating a shoulder dislocation. One rescuer applies traction at the forearm while another applies countertraction at the chest.

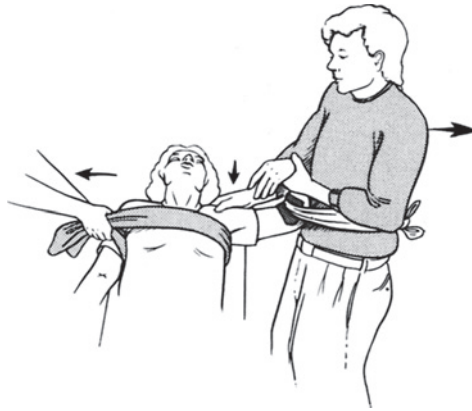


Figure 66. Repositioning a dislocated shoulder. Attached to the victim's forearm with a strap, rope, or sheet, the rescuer uses his body weight to apply traction, leaving his hands free to manipulate the victim's arm. A second rescuer applies countertraction, or the victim can be held motionless by fixing the chest sheet to a tree or ground stake.



Figure 67. Life jacket brace to assist in the relocation of a dislocated humerus.

Another technique is to have the victim lie prone so that his injured arm can dangle free. Place a thick pad under the injured shoulder. Attach a 10 to 20 lb (4.5 to 9 kg) weight to the wrist or forearm (do not have the victim attempt to hold the weight) and allow it to exert steady traction on the arm, using gravity to relocate the humeral head (Figure 68). Alternatively, have the standing victim bend forward at the waist as you pull steadily downward on his arm to simulate the gravity effect, with gentle side-to-side (at the wrist) rotation (Figure 69).

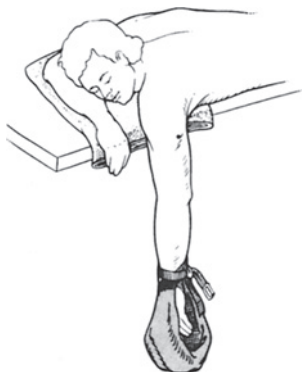


Figure 68. A fanny pack filled with rocks can be used for a weight in the “dangle” method of shoulder relocation.



Figure 69. Pulling on the hanging arm to relocate a dislocated humerus.

In the scapular manipulation technique, the victim is placed in a prone position so that his injured arm can dangle free. Apply traction for 5 to 10 minutes. Then, while maintaining traction, push the tip (lower edge) of the scapula (“wingbone”) in toward the spine while pulling the upper portion (toward the shoulder) of the scapula away from the midline. This can also be done with the victim in a standing position (Figure 70, A). If the victim is standing, it may help to pull the arm forward as well as down (Figure 70, B).

In the Milch technique, the victim attempts self-reduction of the dislocation. He should sit, stand, or lie on his back and slowly reach, using the hand of the injured shoulder, behind the head in order to touch the opposite shoulder.

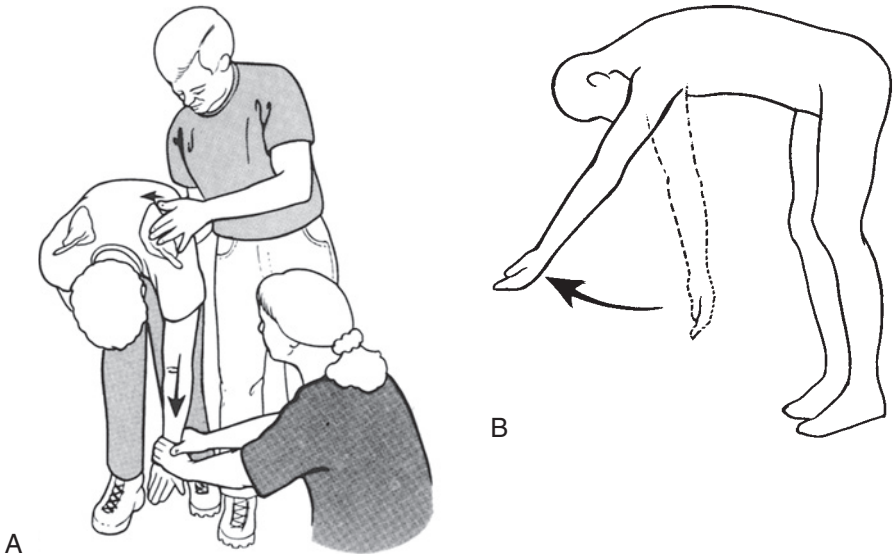


Figure 70. **A,** Pushing the lower edge of the scapula toward the spine while an assistant pulls downward on the hanging arm to assist in the relocation of a dislocated humerus. **B,** The downward pull on the arm may be slightly forward to help put the arm bone back in the shoulder socket.

Another way to describe this technique is to have the victim reach up and backward with the injured arm as if going into a windup to throw a baseball. If the technique works, the victim will feel a “pop” as the dislocation is corrected. If you wish to assist the victim, use one hand to gently cup his elbow and assist him with this procedure, while using your other hand to steady the affected shoulder.

If pain medicine is available, the victim should be medicated before relocation is attempted, to allow the greatest possible shoulder and chest muscle relaxation. As the arm bone moves back into proper position (this may require 15 minutes of steady traction), it will sometimes “give” in little movements, with a final “pop” back into the socket. Once the bone is back in place, the victim will be able to bring his arm across the chest. If the victim cannot relax his muscles sufficiently to allow relocation, if your attempts cause excruciating pain, or if you are otherwise unsuccessful after 30 minutes, leave well enough alone (no one ever died of a dislocated shoulder). Place padding in the armpit and fix the arm near the body in as comfortable a position as possible with swathe bandages, and then head for help. A shoulder harness (Figure 71) may be useful. The victim who cannot walk should be transported in a sitting (for comfort) position, if possible. If the shoulder relocates, it should be placed in a sling and swathe, to prevent a repeat dislocation (see Figure 49). A first-time shoulder dislocation that is relocated should be immobilized for 3 weeks. A recurrent dislocation that is relocated can be exercised gently after 3 to 5 days.

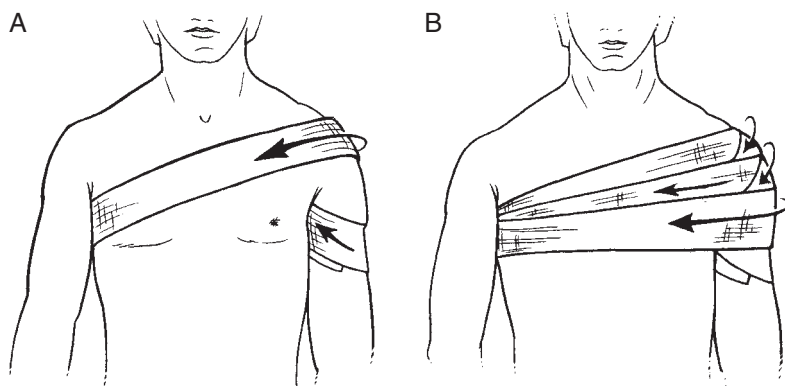


Figure 71. Shoulder harness.

Shoulder Separation

A shoulder separation, as contrasted with a dislocation, occurs when the collarbone's ligamentous attachments to the acromion and coracoid structures of the triangular scapula ("wingbone") are weakened or disrupted (Figure 72). This can range from small tears in the ligaments, which do not result in a visible deformity, to full disruption of the ligaments, leading to a "free-floating" collarbone. The injury usually follows a direct blow to the shoulder, such as occurs when you fall onto your side and cannot break the fall with an outstretched arm.

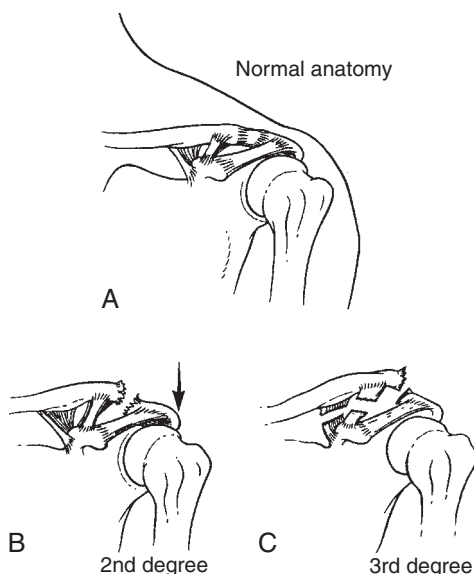


Figure 72. **A**, Ligamentous attachments of the collarbone at the shoulder. **B**, Second-degree shoulder separation. **C**, Third-degree shoulder separation.

If tenderness is elicited when pressing directly over the acromioclavicular joint (AC joint), particularly with swelling and a spongy sensation over the end of the collarbone, suspect a shoulder separation. Treat as for a broken collarbone (see page 87).

Rib

A broken rib can be very painful, but there is little that the rescuer can do to improve the situation. Pad the chest wall with blankets or clothing (if the victim needs to be carried out on a stretcher) to restrict unnecessary motion and contact. Never bind the chest tightly; this inhibits deep breathing and prevents full expansion of the lungs, which predisposes the victim to partial lung collapse and pneumonia. Encourage the victim to breathe deeply (sigh) or cough a few times an hour. If there is a segment of detached (flail) ribs (see page 41), attempt to stabilize its position with padding (see Figures 26 and 29). Because of the force necessary to break a rib, anticipate internal bleeding (lungs, liver, and spleen) (see page 59). A rib will sometimes break during forceful coughing. In this case, internal injury is not a concern.

Spine (Chest and Lower Back)

A victim who falls a great distance and lands on his feet frequently fractures his heel(s), ankle(s), and lumbar vertebrae (lower bones of the spine—see Figure 41). Symptoms of spinal cord injury include back pain, weakness, numbness or tingling below the injury, loss of bladder or bowel control, and low blood pressure (“spinal shock”). If a fractured spine is suspected, the victim must be completely immobilized to avoid damage to the spinal cord. Position him on a firm litter or backboard, and secure him so that no motion of the back is possible (see page 37). If a scoop stretcher or backboard is not available and the victim must be moved, he should be logrolled (see page 39).

Pelvis

If pressing inward on the victim’s hips or downward on the pubic bone causes pain, suspect a fracture of the pelvis, and immobilize the victim from his waist down. A pelvic fracture is frequently associated with severe internal injuries and bleeding, so rapid evacuation is a high priority. Be prepared to treat the victim for shock (see page 60). Do not allow a victim with a suspected pelvic fracture to walk. A SAM Pelvic Sling is a force-controlled circumferential pelvic sling belt for effective reduction and stabilization of pelvic fractures. Another device is the pelvicbinder (www.pelvicbinder.com). If one of these devices is not available, the pelvis can be wrapped tightly with a sheet, sleeping pad (held in place with tape),

blanket, or jacket to attempt to keep the bone fragments from moving, which hopefully diminishes instability, internal bleeding, and pain (Figure 73). Before applying any pelvic sling, be sure to empty the patient's pockets and remove his belt so that the external pressure doesn't press any items against the pelvis. For transport, place padding between the victim's legs and gently tie his legs together to minimize motion and improve comfort.

Femur

A fracture of the femur (the large bone of the upper leg—the longest and strongest bone in the body) can be diagnosed by severe pain, inability to bear weight, deformity, and rapid swelling (from bleeding). Often, the affected leg is shortened and the foot is rotated away from the other leg. Sometimes a fracture of the neck of the femur can be subtle, as the victim complains only of minor pain on the inside of the groin or knee, and may continue to walk. On close inspection, the affected leg may be seen to be slightly shortened, and there may be some swelling and pain in the anterior hip area. Any disabling femur fracture requires splinting from the hip to the ankle. Because the muscles of the thigh are quite powerful and will tend to force the broken bone ends to overlap (Figure 74, A), traction is often necessary to control bleeding, maintain position, decrease pain, and prevent further internal muscle and blood vessel damage (Figure 74, B). If sufficient rescuers are available, one person should maintain firm traction on the leg at the ankle to oppose the strong muscle contractions of the thigh (Figure 75). A broken femur can bleed 2 quarts (liters) of blood into the thigh rapidly, so evacuation is a high priority. Be prepared to treat the victim for shock (see page 60).

The standard Thomas ("half ring") splint allows traction to be applied to the femur. A Hare splint has a ratchet mechanism at the end to provide mechanical traction. A Sager splint allows traction by facilitating lengthening of its long, rigid axis rod. The Kendrick Traction Device is a lightweight, portable field traction apparatus that operates on the same principle and can easily be carried and applied in a wilderness setting. The Slishman Splint, now available in a shortened version, is an excellent, lightweight device.

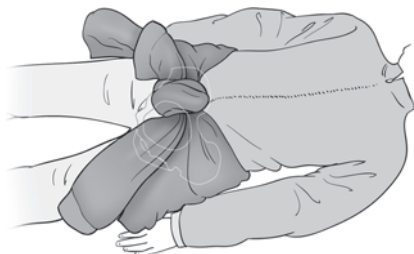


Figure 73. Pelvic sling improvised with a jacket provides compression to the pelvis to control bleeding. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5]. St. Louis: Mosby, 2007, p 515.)

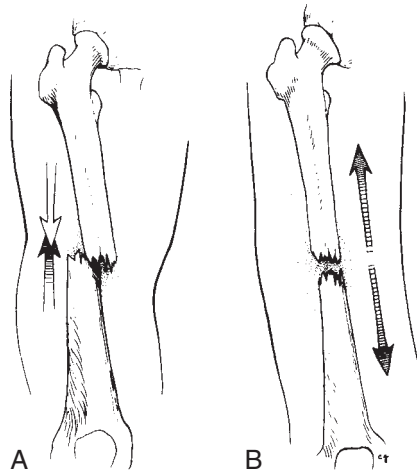


Figure 74. Fracture of the femur. **A**, Without traction, strong muscles of the thigh pull the broken bone ends together, causing pain and deformity. **B**, Traction straightens the leg and helps control bleeding and pain.

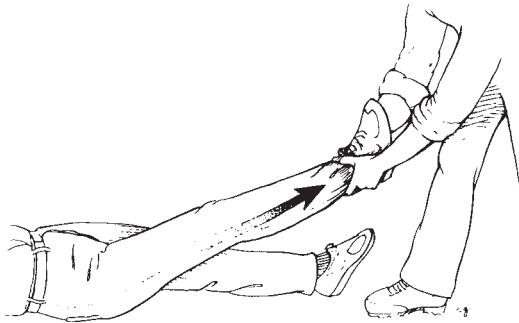


Figure 75. Technique for applying traction to the lower leg.

You can also prepare an improvised traction splint that replicates the features of a Thomas splint: a half ring to anchor up against the pelvic bone (ischial tuberosity) underneath the lower crease of the buttock, two longitudinal rigid rods to run the length of the leg, a fixed spacer at the lower (foot) end between the two rods, and a traction mechanism to pull on the leg to align the fracture.

The ankle should be padded with foam or cloth pads, or a boot should be worn. If the latter is done, you can cut away the toe section to assess the circulation (skin color, sensation) (Figure 76).

A traction harness must be created to pull the leg straight down away from the head. One method is to cut two slits through the victim's sturdy boot, above the sole just in front of the heel and directly below the leg bones. Pass a cravat

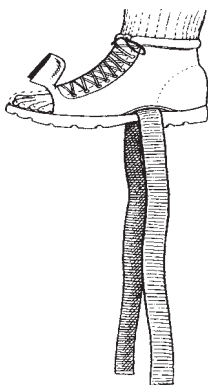


Figure 76. The toe section of a boot can be cut away to allow inspection for adequate circulation. A cravat or piece of webbing can be passed through a boot as the first step in creating a traction harness.

or nylon webbing (such as a pack strap) through the opening (see Figure 76); the ends of the strap will be secured to the rigid object that will form the spacer at the foot end of the leg splint. The paired-loop (“double runner”) method of creating an ankle hitch uses paired lengths of cravat, nylon webbing, or rope (Figure 77, A). Fold each in half, creating a single turn at one end. Lay one cravat over the top of the ankle and one behind the ankle (behind the Achilles tendon), with the curved ends pointed in opposite directions. Pass the free ends of each cravat through the loop in the other cravat, and tighten the cravats so that they fit snugly and flat against the ankle. The free ends should now hang down (Figure 77, B) and will be secured to the spacer, directly or with an interposed pulley system, that connects the long, rigid rods of the splint. Another method to apply traction is “Buck’s traction,” in which a pad is secured firmly around the lower leg in such a way that the pad can get enough purchase to allow it to anchor tape stirrups (Figure 78).

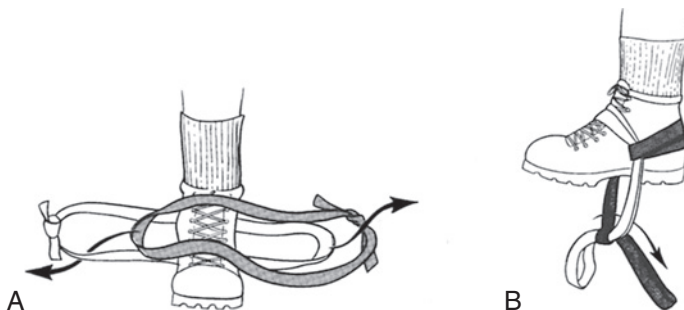


Figure 77. Paired-looped webbing to create an ankle hitch. **A**, Position the webbing around the ankle. **B**, Pull the harness tight with the ends pointed down for fixation to the splint.

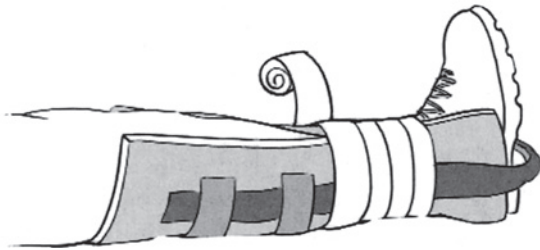
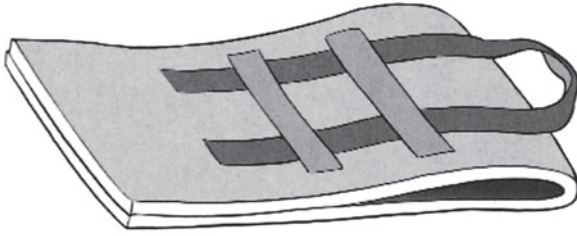


Figure 78. Buck's traction.

The traction splint rods can be fashioned from two ski poles, rigid tree limbs or saplings, tent poles, or anything else that is approximately a foot (30 cm) longer than the distance from the top of the thigh to the bottom of the foot. To measure the proper length, lay the rods next to the victim on either side of the thigh, with the top of the inner rod tucked up against the groin crease and the top of the outer at the top of the thigh. Cut the lengths to be even at a distance of approximately 8 to 12 in (20 to 30 cm) below the foot (Figure 79).

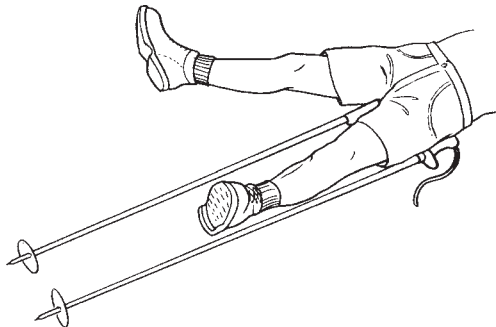


Figure 79. Proper length of traction splint rods.

Construct the splint away from the victim. Using a cravat, ski pole straps, webbing, or rope, attach the tops of the two poles with a length that approximates half the circumference of the thigh at this point, to create the “half ring” that will be snugged up underneath the victim into the lower buttock crease (Figure 80). At the lower (foot) ends of the rods, attach a perpendicular rigid spacer about 8 in (20 cm) in length (Figure 81). This could be a piece of ski pole, a wrench, a piece of tree limb, or the like. Then lay four cravats (two for above the knee, two for below) or straps (that can be fastened) over the rods and wind them to be configured as cradle hitches (Figure 82). These will fix the rods to the leg after traction has been applied. Velcro straps are nice, if you have them.

Holding traction on the leg, lift it enough to slide the splint underneath. Snug the half ring up into the buttock crease, remembering to keep the shorter rod on the inside of the leg. Attach the splint firmly to the leg with tape or a cravat around the front of the thigh (over thick padding, if available) at the top of the splint above the suspected point of the fracture (Figure 83).

Tie the free ends from the traction harness (which you created through the boot or around the ankle) to the spacer at the end of the long splint. Create a “Spanish windlass” by inserting a short, rigid stick or rod between the tied-down

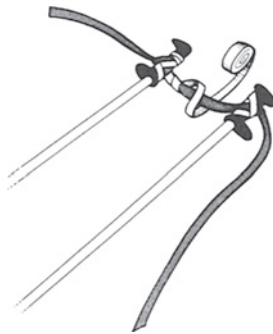


Figure 80. Creation of the half ring, which snugs up into the buttock crease.

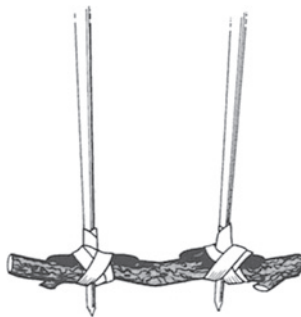


Figure 81. Attachment of the spacer at the foot end between the splint rods.

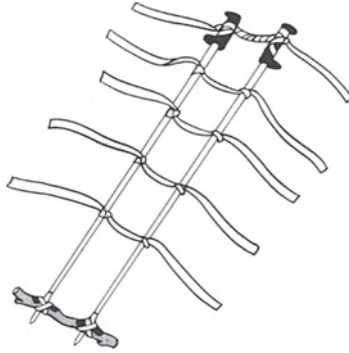


Figure 82. Configuration of cravats for cradle hitches.

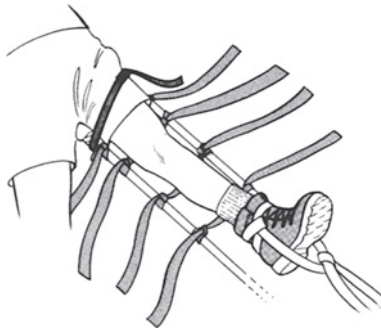


Figure 83. Attaching the splint to the leg above the suspected point of the fracture.

free ends and twisting to produce the desired amount of traction (Figure 84). Fix the twister rod in place by tying it to the adjacent long splint rods (Figure 85).

Finally, secure the splint to the leg with the cradle hitches, two above the knee and two below (Figure 86). Pad everything. The victim may be more comfortable if you apply traction while his knee is slightly bent.

With a broken femur, the rescuer would ideally remove the victim's shoe or boot to be able to assess whether or not the circulation is intact, by checking the dorsalis pedis artery pulse on the top of the foot (see page 33) and observing for normal skin color and sensation. This should only be done if it will not interfere with splinting and if the foot can be protected from the elements (e.g., to avoid frostbite). If the footwear is removed, tent up the sock and cut a hole just large enough to allow a finger to enter to find the pulse and to get a peek at the skin color.

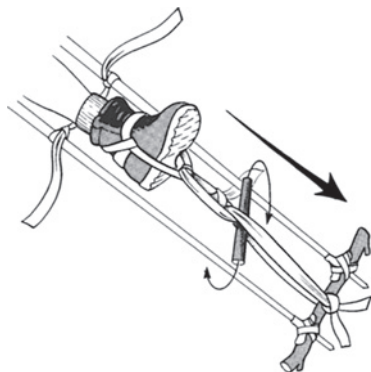


Figure 84. Tie the free ends of the foot harness to the spacer. Then, twist the Spanish windlass to create downward traction on the leg.



Figure 85. After the windlass is twisted to achieve the desired traction, tie the windlass rod to the long struts of the splint to maintain the traction.

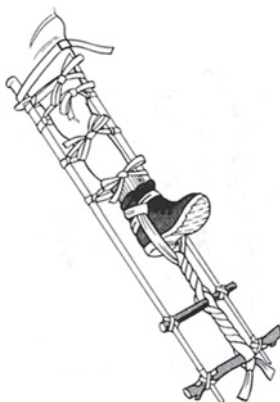


Figure 86. Secure the splint in place by tying off the cradle hitches.

Hip

If a person (usually elderly) falls with great force directly onto his knee, the large leg bone may be forced backward out of the hip socket and create a posterior hip dislocation. In such a case, the affected leg appears shorter and is bent at the knee; the foot and knee are also turned inward (toward the other leg) (Figure 87). With an anterior hip dislocation, the ball of the femur slips forward out of the hip socket, and the leg is shorter and externally rotated (knee and foot face outward) (Figure 88). Either dislocation is a serious condition, because the blood supply to the head of the femur (the “ball” of this ball-and-socket joint) is disrupted. If

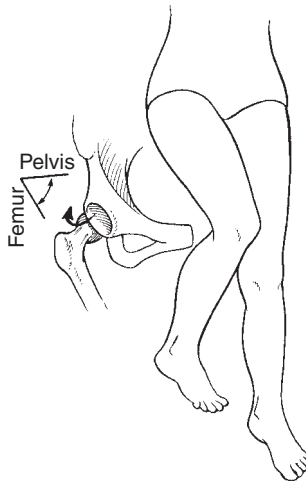


Figure 87. Position of the leg with posterior hip dislocation.

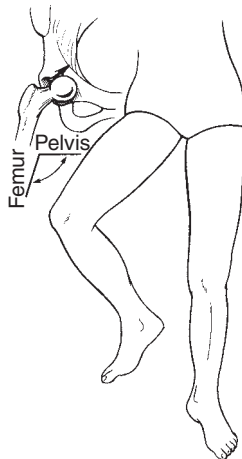


Figure 88. Position of the leg with anterior hip dislocation.

medical attention cannot be reached within 1 hour, make an attempt at relocation—*unless there is a deformity of the upper leg or knee (indicating a fracture)*. Hold the leg and knee of the victim firmly, and exert forceful traction pulling on the thigh directly down toward the victim's feet, in an attempt to slide the head of the femur back into the hip socket. If this is successful, you will feel a "give," and the leg, knee, and foot will regain proper alignment.

Because of the force required to perform this maneuver, it is generally necessary to have a second rescuer provide countertraction to the victim's upper body. The two-rescuer method involves the first rescuer straddling the supine victim directly over his hips, facing toward the victim's head and holding the victim's bent leg between his knees. The second rescuer holds the victim's pelvis to the ground while the first lifts upward on the dislocated femur (Figure 89). If relocation is successful, firmly splint the hip by securing the victim's legs together, slightly bent at the hips and knees with padding in between; he should be promptly evacuated, and should not attempt to walk.

Knee and Kneecap

A suspected fracture of the knee or kneecap should be splinted from hip to ankle. If there is such great deformity that the foot becomes numb and turns blue or pale and cold (usually with severe dislocation of the knee joint), and pulses cannot be felt, then dislocation of the knee joint should be suspected and the rescuer should use traction to attempt to realign the leg in a position of function (with the knee bent at a 15- to 30-degree angle; see Figure 39, B) to reestablish circulation. If pulses do not return after the knee is repositioned, the major artery that traverses the knee joint may have been torn or crushed and occluded. This



Figure 89. Two-rescuer method for repositioning a dislocated hip.

is a surgical emergency. If the relocation attempt is successful, the victim still must be evacuated promptly for a full evaluation.

If the kneecap becomes dislocated, gently straighten the leg while pushing the kneecap from the lateral side back into place. Occasionally, the kneecap will not pop back into position. If the maneuver is painful or not easily accomplished, do not apply force. After the kneecap is repositioned, splint the leg straight or at a 15-degree bend (knee) using an Ensolite or foam pad and elastic bandage(s). If the splint slips, duct tape can be used to fashion suspenders (Figure 90). To prevent the kneecap from becoming dislocated, a person with a history of frequent (patellar) dislocation may choose to wear an Aircast patellar brace or similar support. This stabilizes the kneecap and compresses the surrounding soft tissue with a circular cushion of air.

If the knee has been dislocated or fractured, the victim must be carried. If a kneecap dislocation is the only injury, however, successful treatment will allow the victim to walk, using an ice ax, ski pole, or other object as a crutch.

The knee can be sprained (or strained) when it twists or withstands impact. The supporting ligaments that bind the joint on the outside and inside (lateral and medial collateral ligaments) and those that cross front to back through the interior of the knee joint (cruciate ligaments) can be stretched, slightly torn, or completely disrupted. This causes immediate pain with weight bearing (walking), motion (trying to bend the knee or extend the leg), or touch (pressing against the injured side of the knee). Often, there is swelling and a spongy feel to the knee. As swelling increases, the knee becomes less flexible and more difficult to bend. If you suspect more than a minor sprain, immobilize the knee as if for a fracture; the victim should avoid



Figure 90. Duct tape suspenders support an improvised knee splint.

weight bearing. Sometimes the mechanism of injury can suggest what has been damaged:

- Striking the bent knee from the outside commonly injures the medial collateral ligament.
- Striking the straight knee from the inside commonly injures the lateral collateral ligament.
- Striking the front of the knee commonly injures the posterior cruciate ligament.
- A knee being severely twisted or completely giving out on impact or pivot commonly is caused by anterior cruciate ligament disruption.
- Pain with knee rotation or clicking/locking of the knee may indicate meniscal (cartilaginous cushion within the knee joint) tear.
- Inability to step up (“climb stairs”) after a “pop” is felt or heard may indicate injury to the quadriceps/patellar tendon.

Lower Leg

A fracture of the lower leg should be splinted from knee to ankle. If necessary, the legs can be attached side by side with padding in between. If the knee is not involved, keep it bent at 15 to 30 degrees.

Ankle

A fracture of the ankle can be stirrup-splinted or wrapped to prevent movement. This can be accomplished using a SAM Splint, parka, or piece of rolled foam taped or wrapped into place (Figures 91 and 92). Remove or loosen the boot or shoe to avoid entrapment due to swelling, which could impair circulation.

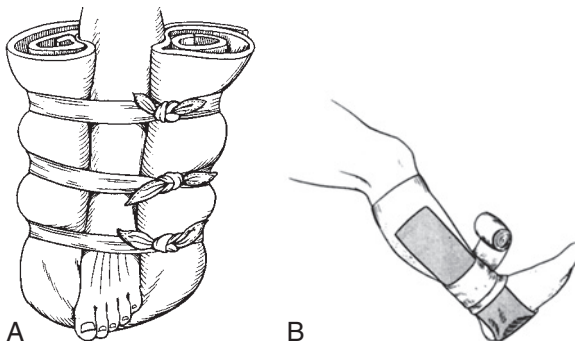


Figure 91. Methods of foot and ankle immobilization. **A**, A piece of rolled foam can be used as a “stirrup” to hold the foot and ankle motionless. **B**, The SAM Splint is easily configured in a similar fashion.

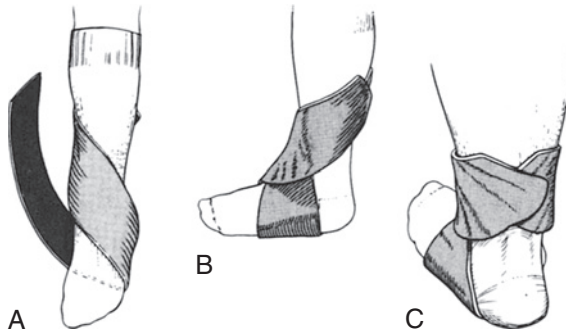


Figure 92. Ankle fixation with the SAM Splint. **A,** The splint is wrapped in a figure-of-eight over the top of the ankle. **B,** The aluminum is molded to fit snugly against the foot and lower leg. **C,** Rear view of completed splint.

However, if the victim must walk out under his own power, replace footwear as soon as possible, before swelling makes this impossible.

Toe

A fractured toe may be splinted by buddy-taping. This is performed by placing some padding (cloth or cotton) between the toes and taping the injured toe to a healthy adjacent toe for support.

AMPUTATION

Amputation is detachment of a body part, such as an ear, finger, or foot. It is usually associated with a serious force or crushing injury, such as an animal bite. The immediate threats to life are bleeding and shock (see page 60).

If a body part is detached, apply firm pressure to the site of the bleeding where the tissue loss has occurred. Manage any serious bleeding (see page 54). Cover the wound with the cleanest available bandage, and then wrap firmly. *Do not attempt to reattach the detached body part.* If a digit is hanging on by a small “bridge” of skin or muscle, attempt to bandage it without completing the separation.

If the body part can be easily recovered and the victim can be brought to a hospital within 6 hours of the injury, do the following:

1. Gently rinse the body part if the cut end is contaminated with dirt.
2. Wrap the body part in clean cloth or gauze and keep the covering moist. The ideal solution is saline (*not* ocean water, because of infection risk), if that is available; if not, fresh water will do. Do not immerse the part in a bag of water; merely keep the covering moist. Keep the body part cool by placing it on ice after wrapping it securely in a bandage, cloth, or towel. To avoid a frostbite injury, *do not apply ice directly to the body part or immerse it in ice water.*
3. Bring the body part with the victim to the hospital.

The application of a tourniquet to stop bleeding is essentially a decision to sacrifice the limb in order to preserve life. If any salvageable part of the limb is still attached, do not apply a tourniquet to stop bleeding until you have exhausted all pressure techniques (see page 54). If the limb is completely severed and the bleeding is torrential, a tourniquet may be applied until the muscular walls of the arteries constrict and bleeding can be controlled by direct pressure. Tie a cloth or rope circumferentially an inch or two above the wound and tighten it just enough to allow direct pressure to stop the bleeding (see page 56). After 5 to 10 minutes, loosen the tourniquet briefly to see if the bleeding can be controlled with pressure techniques alone.



DEFINITIONS (FIGURE 93)

First-degree burn. This is a burn that involves the outermost layer of skin, the epidermis. It is often quite painful. The skin is reddened, but there is no blister formation. When a large surface area is involved, as with an extensive sunburn, the victim may become quite ill, with fever, weakness, chills, and vomiting.

Second-degree burn. This is a burn that involves the epidermis and portions of the next-deeper layer of the skin, called the dermis, which contains the sweat glands, hair follicles, and small blood vessels. It is usually more painful than a first-degree burn, and blisters are present. Large areas of second-degree

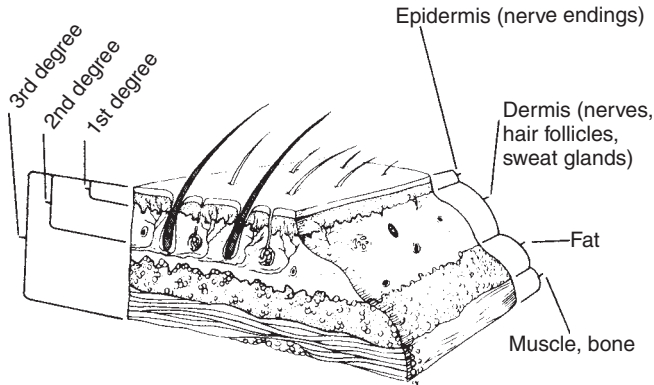


Figure 93. Burn wound. Note that third-degree (full-thickness) burns completely destroy nerves and are painless.

injury impair the body's ability to control temperature and retain moisture. Thus, a severely burned victim loses large amounts of fluid and can rapidly become hypothermic in a cold environment.

Third-degree burn. This is a burn that has penetrated the entire thickness of the skin, and may involve muscle, bone, and so on. It is typically painless because of nerve destruction. The appearance is dry, hard, leathery, and charred. Occasionally, the skin will appear waxy and white with small clotted blood vessels visible as purple or maroon lines below the surface. Because a third-degree burn is usually surrounded by an area of second-degree injury, the edges of the wound may be quite painful. Third-degree burns nearly always require a skin graft for coverage.

Partial-thickness burn. First-degree or second-degree burn.

Full-thickness burn. Third-degree burn.

Inhalation injury. This is a burn that involves any portion of the airway. Inhalation injury occurs when a victim is trapped in a fire and inhales smoke, steam, or superheated air (see page 114).

TREATMENT FOR BURNS

1. Remove the victim from the source of the burn. If his clothing is on fire, roll him on the ground or smother him in a blanket to extinguish the flames. Remove all materials that are hot or burned. If the victim has been burned with chemicals, *gallons* of water should be used to wash off the harmful agents. If chemicals may be present in an article of clothing, remove it. If the eyes are involved, they should be irrigated copiously. Phosphorus ignites on contact with air, so any phosphorus in contact with the skin must be kept covered with water. Do not attempt to neutralize acid burns with alkaline solutions or vice versa; the resultant chemical reaction may liberate

heat and worsen the injury. Stick to irrigation with water. If clothing remains stuck to the skin and does not fall away with irrigation, do not tear the clothing away. Cut around it.

2. Evaluate the airway. Look for evidence of an inhalation injury: burns of the face and mouth, singed nasal hairs, soot in the mouth, swollen tongue, drooling and difficulty in swallowing saliva, muffled voice, coarse or difficult breathing, coughing, and wheezing. If it appears that an inhalation injury has occurred, administer oxygen (see page 431) by face mask at a flow rate of 5 to 10 liters per minute, and transport the victim to a hospital as quickly as possible.
3. Examine the victim for other injuries. Unless the airway is involved or the victim is horribly burned, the burn injury will not be immediately life threatening. In your eagerness to treat the burn, don't overlook a serious injury such as a broken neck. Control all bleeding and attend to broken bones before applying burn dressings.
4. Treat the burn:

First-degree: A first-degree burn, such as a mild to moderate sunburn, may be treated with cool, wet compresses for 10 to 20 minutes. If the burn is acquired suddenly (as when a child grabs a hot rock), immediate application of very cold water (not solid ice) may help limit the extent of the tissue damage. Oral administration of an antiinflammatory drug, such as aspirin or ibuprofen, may provide considerable relief. For severe sunburn ("lobster body"), the administration of oral prednisone in a rapid taper (80 mg the first day, 60 mg the second, 40 mg the third, 20 mg the fourth, 10 mg the fifth) may be extremely helpful. Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

Topical corticosteroid creams or ointments are of no benefit in treating a burn wound. Anesthetic sprays that contain benzocaine work for a few hours, but may induce allergic reactions. They should be used sparingly. If no blisters are present, a moisturizing cream (such as Vaseline Intensive Care) will help soothe the skin. Aloe vera gel or lotion seems to promote resolution of extensive first-degree burns. Burnaid first-aid burn gel (Rye Pharmaceuticals), which also comes in an impregnated dressing, contains 2% to 4% melaleuca oil and is advertised to provide relief from the pain of minor burns and scalds.

Second-degree: A second-degree burn should be irrigated gently to remove all loose dirt and skin. This should be done with the cleanest cool water available. *Never apply ice directly to a burn;* this may cause more extensive tissue damage. Cool compresses may be used for pain relief for 10 to 20 minutes. Mild soap and water may be used to clean the burn.

After the wound is clean and dry, cover it with a soft, bulky dressing made of gauze or cloth bandages, taking care to keep the dressing snug but not tight. If antiseptic cream such as silver sulfadiazine

(Silvadene) is available, it should be applied under the dressing. Silver sulfadiazine should not be used on the face or in victims who are pregnant, infants, or nursing mothers with children younger than 2 months. An alternative is mupirocin ointment or cream, or bacitracin ointment. A nonadherent dressing layer directly over the antiseptic is easier to change than coarse gauze. Another excellent covering is Spenco 2nd Skin underneath an absorbent sterile dressing. Spenco 2nd Skin is an inert hydrogel composed of water and polyethylene oxide. It absorbs fluids (so long as it doesn't dry out), which "wicks" serum and secretions away from the wound and promotes wound healing. Other occlusive hydrogel-type dressings are NU-GEL (preserved polyvinyl pyrrolidone in water) and Hydrogel, which can absorb up to 2½ times its weight in exuded (from the wound) fluids. Yet another covering for a burn is a layer of petrolatum-impregnated Aquaphor gauze under a dry (absorbent) gauze dressing.

Do not apply butter, lanolin, vitamin E cream, or any steroid preparation to a burn. These can all inhibit wound healing, and may facilitate infections with increased scarring.

Dressings should be changed each day to readjust for swelling and to check for signs of infection. Be certain to keep burned arms and legs elevated as best possible, to minimize swelling and pain.

Blisters should not be opened, unless they are obviously infected and contain pus (this will generally not occur until 24 to 48 hours after the burn injury). If a blister remains filled with clear fluid, it is an excellent covering for the wound and will minimize fluid loss and infection. There is no rush to remove charred skin from a burn wound. As the wound matures and dressings are changed, gentle scrubbing will lift off dead tissue.

A victim with large areas of second-degree burns may need to be treated for shock (see page 60).

Third-degree: A third-degree burn should be irrigated gently and may be cleansed with mild soap and water. It should then be covered with antiseptic cream or ointment or Spenco 2nd Skin, and a dry sterile dressing.

If a first-degree burn involves more than 20% of the body surface area and the victim suffers from fever, chills, or vomiting, a physician evaluation is required. If a second-degree burn involves a significant portion of the face, eyes, hands, feet, genitals, or an area greater than 5% of the total body surface area, a physician evaluation is required. Body surface area can be estimated using the "rule of nines" (Figure 94). For an adult, each upper limb equals 9% of total body surface area (TBSA), each lower limb equals 18%, the anterior and posterior trunk equal 18% each, the head and neck combined equal 9%, and the genital/groin area (perineum) equals 1%. For a small child, each upper limb equals 9% of TBSA, each lower limb equals 14%, the anterior and posterior trunk equal 18% each, the

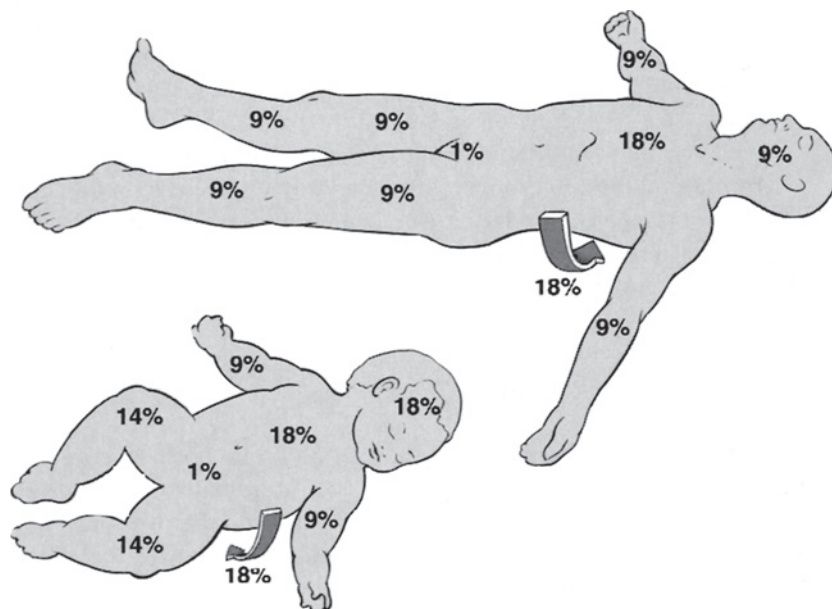


Figure 94. Rule of nines for body surface area estimate.

head and neck combined equal 18%, and the perineum equals 1%. Another method to estimate involved body surface area is the “palm of hand” rule: The surface area of the victim’s palm with the fingers represents approximately 1% to 1.5% of his TBSA. All third-degree burns are serious and should be seen by a physician.

Wet versus Dry Dressings

If the burn surface area is small (less than 10% of total body surface area), cool, moist dressings (*not ice*) may be used to initially cover the burn wound. These often provide greater pain relief than do dry dressings. If the surface area involved is large, however, dry, nonadherent dressings should be used, to avoid overcooling the victim and introducing hypothermia (see page 305). Because the skin is the major thermoregulatory organ of the body, it is difficult for an extensively burned victim to control his body temperature, so great care must be taken when wetting down such a person. If the victim begins to shiver, the cooling is too extreme.

Fluid Replacement

A person who has suffered an extensive burn will rapidly become dehydrated. Because water quickly shifts from the blood volume into the tissues of the body, the injured skin cannot retain moisture, and associated immune suppression

leads to overwhelming infection and shock. Oral rehydration with balanced salt solutions is little help, but in the wilderness, it is usually the only option. Try to get the victim to drink—in sips, if necessary—enough liquid to keep the urine copious and clear (see page 208). If a burned victim cannot drink because his airway is injured, consciousness is altered, weakness prevails, or vomiting is persistent, immediately call for an evacuation.

Antibiotics

Antibiotics are not necessary for burns unless they become infected. This is indicated by the presence of pus, foul odor, cloudy blisters, increased redness and swelling in the normal skin that surrounds the burn, and fever greater than 101°F (38.3°C). If a burn becomes infected, administer dicloxacillin, cephalexin, or erythromycin, and be certain to change all dressings daily. If a person sustains a serious burn that becomes infected after exposure to ocean water, administer ciprofloxacin, doxycycline, or trimethoprim-sulfamethoxazole in addition to the other antibiotic chosen. Blisters that appear to be infected should be “unroofed” and drained, then covered with a proper dressing.

Tar Burn

If a victim is splashed with hot roofing tar or paving asphalt, immediately immerse the affected area in cool water to solidify the tar and limit the burn. If a small area is covered with tar and you cannot reach a physician, you can remove the tar by gently massaging it with repeated coatings of bacitracin or mupirocin ointment, or mayonnaise, which will turn brown as the tar dissolves into it. Do not injure the skin by attempting to roughly peel off the tar. After the tar is removed, treat the burn as described previously. If you cannot dissolve the tar, cover the wound with bacitracin ointment or mupirocin ointment or cream, and a clean dressing.

BURN PREVENTION

1. Obey all posted warnings regarding campfires.
2. Use flame-resistant tents and sleeping bags.
3. Keep all campfires a sufficient distance (minimum 20 feet) from tents and other flammable materials. Create a clear, fuel-free perimeter of at least 3 feet around any campfire or grill. Do not sit too close to a campfire, particularly in windy conditions. Do not allow children to play near a campfire.
4. Do not add lighter fluid, gasoline, kerosene, or any other flammable liquid to a flaming fire or hot coals/embers.
5. Store flammable liquids in approved metal containers that are tightly sealed. Do not fill lamps and stoves with fuel anywhere near intense heat

or open flames. Use a funnel to pour flammable liquids, and clean up any spills immediately.

6. Keep a bucket of water within easy reach of a campfire.
7. Thoroughly extinguish the campfire before going to sleep or leaving the campsite.
8. Do not handle camp sauna hot rocks or cook pots without wearing proper hand protection.
9. Do not allow children to handle containers with hot water.
10. Do not set containers of hot water or food on unstable or uneven surfaces.
11. Use battery-operated lights in or near tents or campers.



INHALATION INJURIES

Inhalation injuries include thermal (heat) and chemical (smoke, noxious gas) inhalations. A third type of inhalation injury is aspiration (inhalation) of stomach contents; blood; or ocean, river, lake, or pool water into the lungs. The severity of the injury is determined by the chemical nature of the substance, temperature, volume of inhaled material, and underlying health of the victim. In a likely scenario, such as a boating accident or a seizure that occurred in the water, you must have a high index of suspicion for an inhalation injury. Drowning is discussed on page 406.

THERMAL INJURY

In thermal inhalation, the airway is injured by the introduction of superheated air or steam. Such injuries almost always occur in an enclosed environment, although occasional mishaps occur in association with wildland fires (see page). Because water conducts heat approximately 30 times as efficiently as air, the risk of injury is far greater with steam than with dry superheated air.

The heat injures the inside of the mouth and nose, throat, vocal cords, trachea, bronchi, and occasionally lungs. External signs of an inhalation injury include burns of the face and mouth, singed nasal hairs, and soot in the mouth and nose. Symptoms include shortness of breath; wheezing; coughing (particularly of carbonaceous

black sputum); raspy, coarse breathing (stridor) noted most often during inspiration, with a barking quality that seems to originate in the neck; muffled voice; drooling; difficulty swallowing; swollen tongue; and agitation.

Once the burn injury has occurred, there is no effective way to limit its progress, so *the victim should be transported as rapidly as possible to an emergency facility*. If oxygen (see page 431) is available, it should be administered at a flow rate of 5 to 10 liters per minute by face mask. If the victim's condition deteriorates rapidly because the airway becomes swollen and obstructed, the only hope for survival is the placement of a tube directly through the vocal cords and into the trachea, or the creation of an air passage through the neck (tracheotomy).

SMOKE (CHEMICAL) INJURY

Most smoke is composed of soot and various chemicals. Although each specific substance causes its own variation on the basic lung injury, the immediate first-aid approach is the same: Remove the victim from the offending agent, and *immediately administer oxygen* at a flow rate of 5 to 10 liters per minute (see page 431) by face mask. If the victim is having difficulty breathing or is without respirations, he should be supported with mouth-to-mouth breathing (see page 29). Difficulty in breathing may be delayed for a few hours after smoke inhalation, so a victim should seek immediate medical attention even if he feels fine initially.

The utmost caution must be exercised when removing a victim from the source of suspected toxic gases, so as not to create additional victims. Rescuers should wear gas masks if they are available. Carbon monoxide intoxication is discussed on page 334.

Smoke from wildland fires can affect your health. A person does not acclimate to smoke in any way, and repeated exposures can diminish lung function. So, avoidance is very important.

Intense exposure to heat and smoke when in the immediate proximity of a raging forest fire causes burns, asphyxiation from lack of oxygen, carbon monoxide poisoning, and injury by other severe, acute causations.

Smoke exposure of a degree to create a hazy horizon, where you can see, smell, and taste the smoke, may also cause health problems. Healthy persons are usually not at a major risk from such smoke. But of course, it's always a good idea to avoid breathing smoke if you can help it. Smoke is not good for you.

Smoke is a mixture of gases and fine particles produced when wood and other organic matter burn. It reflects the fuel, so can contain products of combustion from rubber, plastics, and any other material consumed in the blaze. Firefighters have the greatest exposures to smoke, and they are often affected. It has been estimated that nearly 40% to 50% of medical encounters by wildland firefighters are for respiratory problems. Whether or not this statistic can be perfectly extrapolated to a nonfirefighter population passively exposed to wildfire-generated smoke is not known, but it is highly likely that respiratory ailments and diminished lung function would be a logical result of exposure to smoke.

What's in the smoke? Some of the combustion products of concern include these classes of materials: particulate matter (organic and inorganic), carbon monoxide, ozone, organic acids, polynuclear aromatic hydrocarbons, volatile and semivolatile organic compounds, and free radicals. These are present or absent in varying degrees depending on the fuel burned, temperature of the fire, suppression method(s) used, and other factors. Therefore, the toxicity of the smoke may vary, but for the purposes of this discussion, all smoke from wildland fires should be considered comparable.

Because particulate matter dominates in proportion within wildland fire smoke, the greatest health threat from smoke comes from the fine particles, which are often microscopic. The particles easily get into the eyes and respiratory system, where they can cause health problems such as burning eyes (conjunctivitis), irritated throat, runny nose (sometimes associated with an allergic response), and illnesses such as bronchitis (cough). Fine particles also can worsen chronic heart and lung diseases. Because death rates from these conditions have been noted to rise in a smoky environment, the smoke has been linked to premature deaths in people with these conditions, in a fashion analogous to increased mortality rates during heat waves.

Persons who are more susceptible to ill effects at lower smoke levels are those with heart disease (congestive heart failure, symptomatic angina, cardiomyopathy), lung disease (asthma, reactive airway disease, chronic obstructive pulmonary disease [COPD]), and any medical condition in which oxygen delivery and heart and lung function are essential for health and wellness.

Older adults appear to be at increased risk of being affected by smoke, as do children with high activity levels. Firefighters, athletes, soldiers, and others who exercise in smoky conditions often report feeling poorly, sometimes up to the point of incapacitation.

It is not difficult to know if smoke is affecting you, if you develop symptoms. It is less easy to know if you are being affected if the impact is subtle. Obvious symptoms are irritated and reddened eyes; painful throat; fatigue; decreased exercise tolerance; palpitations; chest pain; shortness of breath or inability to draw a deep breath; coughing; wheezing; sinus irritation; headache; or worsening of preexisting conditions that manifest any of these symptoms.

Prevention is key. One must know how to limit exposure to smoke:

1. Pay attention to local air quality reports, and to the Environmental Protection Agency's Air Quality Index (AQI). Stay alert for any news coverage or health warnings related to smoke. Use visibility guides, if they're available. Not every community has a monitor that measures particle levels in the air. In the western United States, some areas without air quality monitors have developed guidelines to help people estimate the AQI based on how far they can see.
2. Common sense is the cornerstone of everything we do in wilderness medicine. If it's smoky outside, do not plan to exert yourself. Do not run the race, and consider keeping your children indoors. If you develop smoke-related symptoms, curtail any contributing activities and seek an environment away from the smoke. Ordinary dust masks are designed to

filter out large particles, so do not count on them to diminish exposure to small particulate matter found in smoke.

3. The air indoors is also important during times of high smoke levels outdoors. So, you should keep indoor air as clean as possible. Unless it is extremely hot outside and you need to open windows and doors for air circulation, you should keep them closed. If you have an air conditioner, allow it to run, with the fresh air intake closed and the filter clean. Certain air cleaners might decrease particulate matter indoors, but be certain that the device does not emit ozone. Do not smoke tobacco products, and do not burn anything that will emit smoke. If it becomes too hot inside a building or enclosure, find a cooler shelter, so that you are not overcome by the heat. When driving a car in smoky areas, keep the windows and vents closed.

AIR QUALITY INDEX (AQI) FOR PARTICLES

The AQI, which is often depicted as a color-coded chart, is an index for reporting daily air quality that indicates how clean or polluted the air is, and what associated health effects might be of concern. The Environmental Protection Agency (EPA) calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in the United States. In the setting of smoke from a wildland fire, it is the particulate matter that is of greatest concern.

The AQI is reported as a numerical rating that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. For example, an AQI value of 50 represents good air quality with little potential to affect public health, whereas an AQI value over 300 represents hazardous air quality. When AQI values are above 100, air quality is considered to be unhealthy, at first for sensitive (to the harmful components) groups of people, and then for everyone as AQI values get higher.

The AQI categories are

- *0 to 50 (Green): Good.* Air quality is considered satisfactory, and air pollution poses little or no risk.
- *51 to 100 (Yellow): Moderate.* Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a small number of people.
- *101 to 150 (Orange): Unhealthy for Sensitive Groups.* Members of sensitive groups may experience health effects. The general public is not likely to be affected when the AQI is in this range.
- *151 to 200 (Red): Unhealthy.* Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.
- *201 to 300 (Purple): Very Unhealthy.* This triggers a health alert, because everyone may experience more serious health effects.

- 301 to 500 (*Maroon*): *Hazardous*. This triggers health warnings of an emergency nature. The entire population is more likely to be affected.

People living in close proximity to the fire-stricken areas should remain indoors and avoid inhalation of smoke, ashes, and particulate matter in the area. Ordinary dust masks, designed to filter out large particles, will not help because they allow the more dangerous smaller particles to pass through. High-efficiency particulate air (HEPA) filter masks can remove nearly all airborne particles 0.3 micrometers (microns) in diameter, but they are more expensive and may be difficult to use for people with lung disease, because it can be hard to draw air through them.

If outdoor trips in smoky areas are necessary, breathing through a damp cloth may help filter out some of the particles that are floating in the air, but this is a temporizing measure only and should not be counted on to significantly diminish smoke exposure for more than a few minutes.

ASPIRATION INJURY

Vomiting and inhalation of stomach contents is a common complication of severe hypothermia or drug overdose, and often follows head injury. The key factor is altered mental status, because a person who has a depressed level of consciousness does not protect his airway. In any situation in which a victim is unconscious and prone to vomit, *and the neck is known to be uninjured*, place the victim on his side so that vomitus and blood will drain from his mouth to the ground, rather than into his lungs. If you suspect a neck injury, and the victim must be kept on his back with the neck immobilized, keep constant watch for vomiting. If the victim vomits, he must be quickly turned on a stretcher or backboard or logrolled (see page 39), and his mouth manually cleared of debris.



POISONING

See page 416.



ABDOMINAL PAIN

The causes of abdominal pain are myriad, but may be categorized by classical symptom complexes. As with most disorders, there are serious causes and minor disturbances. The purpose of taking a history and performing a physical examination is to determine the urgency of the situation, in order to plan for evacuation if necessary. Because differentiation between various causes is often difficult, the recommendations that follow are ultraconservative. Any person with severe abdominal pain should be seen by a physician as soon as possible.

GENERAL EVALUATION

Obtain the following history:

1. *Nature of the pain.* Is the pain sharp (knife-like), aching (constant), colicky (intermittent and severe), or cramping (squeezing)? Has the victim ever suffered a similar episode? Been given a specific diagnosis?
2. *Location of the pain.* Is the pain well localized to one particular area, or does it radiate to another region (from the back to the groin, for example)? Did the pain begin in one region and move to another?
3. *Mode of onset of the pain.* Did the pain occur suddenly, or has it gradually increased in intensity? How long has the victim been in pain?
4. *Associated symptoms.* Is the victim short of breath, nauseated, vomiting, suffering from diarrhea or constipation, or dizzy? Is the victim vomiting blood, bile (green liquid produced by the gallbladder), or “coffee grounds” (blood darkened by stomach acid)? Does the vomit smell like feces?
5. *Relief of pain.* Is there a position that the victim can assume that will lessen the pain? Does the victim feel better in a quiet position, or is he agitated and constantly moving around?
6. *Menstrual history.* In the female victim, it is important to determine if there is any chance that the abdominal pain is related to a disorder of pregnancy.

PHYSICAL EXAMINATION

Perform the following physical examination:

1. Observe the victim. Note whether he is active or avoids movement. If possible, note the severity of distress when the victim has his attention diverted (and so is not focusing all of his attention on your examination).

2. Note the victim's skin color, pulse rate and strength, rate of respirations, effort of breathing, mental status, and temperature. Abnormalities of any of these heighten the possibility of a serious problem.
3. Examine the abdomen. This is best done by having the victim lie quietly on his back, with his knees drawn up. Gently press on the abdomen, *proceeding from the area of least discomfort to the area of greatest discomfort*. For the purposes of examination, the abdomen can be divided by perpendicular lines through the navel into four quadrants: right upper, left upper, right lower, and left lower (Figure 95). The epigastrium is the area of the abdomen directly below (not underneath) the breastbone in the midline. Note where the victim complains of pain and whether the pain is affected by your examination. If the victim has increased sharp pain when you suddenly release your hands from his abdomen after a pressing maneuver, this may indicate "rebound" pain associated with general inflammation of the lining of the abdominal cavity (peritonitis). Rebound pain may be caused by severe infection or leakage of blood or stomach/bowel contents into the abdominal (peritoneal) cavity, or by other problems that are generally quite severe.

When a specific area of the abdomen is tender, there are certain disorders to consider:

Epigastrium. Heart attack, ulcer, gastroenteritis, heartburn, pancreatitis.

Right upper quadrant. Injured liver, hepatitis, gallstones, pneumonia.

Left upper quadrant. Injured spleen, gastroenteritis, pancreatitis, pneumonia.

Right lower quadrant. Appendicitis, kidney stone, ovarian infection (pelvic inflammatory disease), ectopic (fallopian tube ["tubal"]) pregnancy, colitis, bowel obstruction, hernia, miscarriage, kidney stone, painful menses.

Left lower quadrant. Diverticulitis, colitis, kidney stone, ovarian infection, ectopic (fallopian tube ["tubal"]) pregnancy, bowel obstruction, hernia, miscarriage, kidney stone, painful menses.

Lower abdomen (central). Abdominal aortic aneurysm, ovarian infection, ovulation disorder, ectopic (fallopian tube ["tubal"]) pregnancy, bladder infection, colitis, bowel obstruction, inflammatory bowel disease ("irritable bowel").

Flank. Abdominal aortic aneurysm, kidney stone, kidney infection, pneumonia.

By quadrant, brief descriptions of and treatments for these disorders follow.

EPIGASTRIUM

Heart Attack (See Page 50)

The symptoms of a heart attack can include pain that is located in the epigastrium, rather than in the chest. If the victim has a history of heart disease and complains of dull epigastric pain, nausea, shortness of breath, and weakness, consider the possibility of a heart attack. If you suspect a heart attack, even minimally, plan for immediate rescue or evacuation.

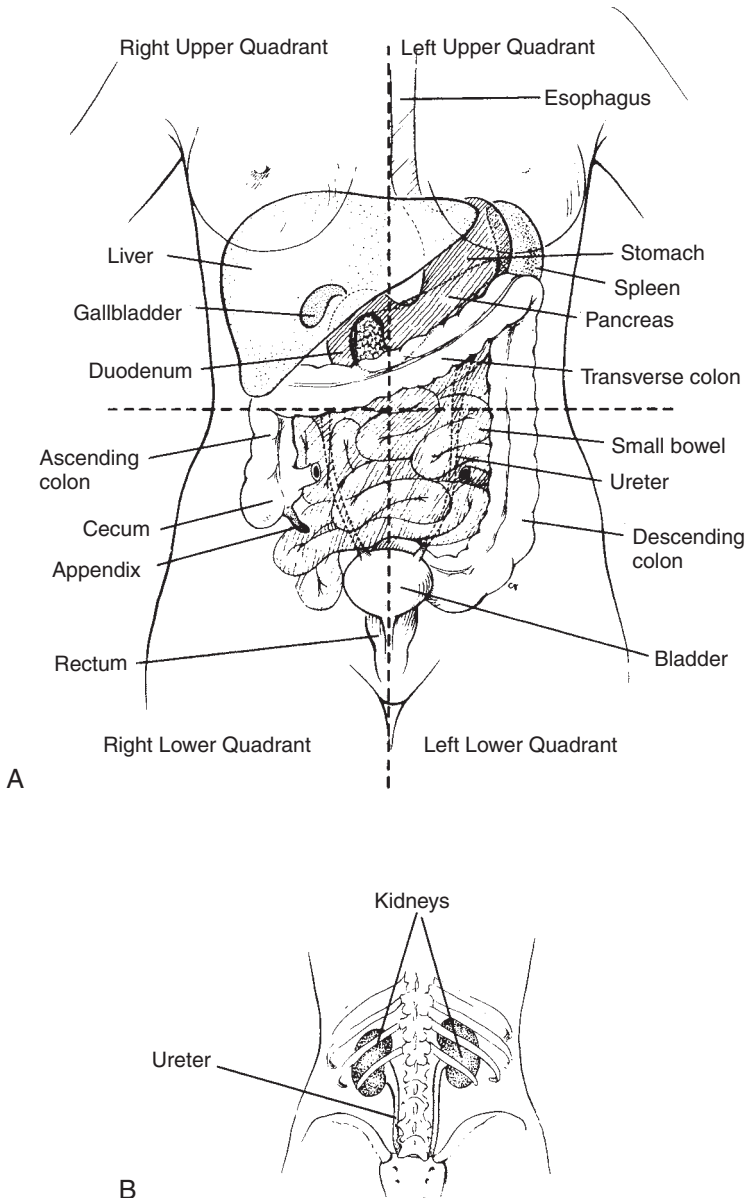


Figure 95. Location of the abdominal organs. **A**, View from the front, with the abdomen divided into four quadrants. **B**, The kidneys are located posteriorly, and may be the cause of flank or back pain.

Ulcer (See Also Page 223)

An ulcer is an erosion in the lining of the stomach (gastric ulcer) or duodenum (peptic ulcer) that penetrates the protective mucous layer and allows acid and digestive juices to erode deeper into the tissues (Figure 96). This causes extreme pain and can lead to bleeding from leaking blood vessels in the ulcer crater. Symptoms include constant burning pain in the epigastrium that is made worse by pressing and is often associated with nausea and/or belching. In a minor case, the pain may be relieved by a meal. In a severe case, when the ulcer has eroded into a blood vessel or has perforated the wall of the stomach or bowel, the victim will vomit red blood or dark brown clotted blood (“coffee grounds”) and complain of pain that may radiate to his back. Rebound tenderness and peritonitis may be present. Dark black tarry bowel movements (melena) are caused by blood that has made its transit through the bowel. Bright red blood or blood clots with a bowel movement can be caused by brisk bleeding from an ulcer, but more commonly originate from bleeding that is occurring within the large intestine (colon) or rectum, or from hemorrhoids (see page 220). Mild bleeding from an ulcer may actually transiently decrease the pain, because blood acts as an antacid. Some ulcers are caused by bacterial (usually, *Helicobacter pylori*) infection. To eradicate the bacteria and allow the ulcer to heal, a physician must prescribe specific, intense antibiotic therapy.

Gastroenteritis

Gastroenteritis is often called the “stomach flu” (see the discussion of diarrhea on page 207). Symptoms include waves of crampy upper and/or lower abdominal pain, followed by loose bowel movements. Nausea and vomiting may be present.

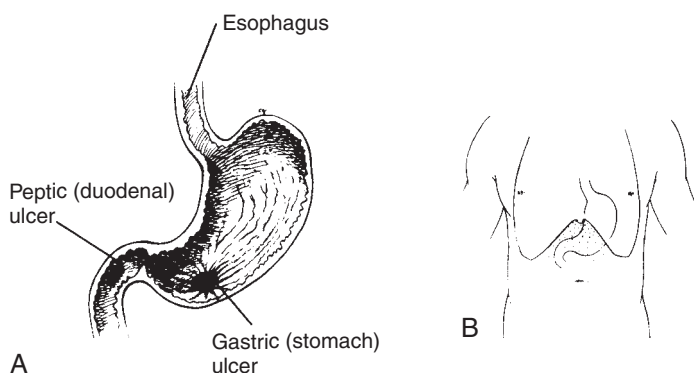


Figure 96. Ulcers. **A**, Location of ulcer craters in the duodenum and stomach. **B**, Epigastric region of the abdomen, where ulcer pain is often noted.

Occasionally, the victim has symptoms of an upper respiratory infection, with cough, runny nose, sore throat, headache, and fever. The treatment for viral gastroenteritis consists of an adequate liquid diet (hydration is the key to recovery—see page 208) and medicine for intractable vomiting (see page 222). When a victim vomits green bile, this should be taken as a sign that the problem is more serious than straightforward gastroenteritis, although bilious vomiting can occur with repetitive retching, when the stomach has been emptied and duodenal contents are all that is left for regurgitation.

Heartburn

See page 221.

Pancreatitis

The pancreas is an organ situated in the posterior upper abdomen that secretes a number of enzymes used to digest food. The pancreas also secretes insulin, the hormone that allows us to use and store glucose. The digestive enzymes travel from the pancreas through a duct, from which they are released through a small opening into the duodenum (the first portion of the bowel after the stomach). If the pancreas becomes inflamed, either by alcohol abuse (heavy drinking is far and away the most common cause), viral infection, or blockage of the main secretory duct by a gallstone, severe epigastric pain is the rule. Sometimes the victim will have diffuse abdominal pain with radiation to the back. Pain is accompanied by nausea and vomiting (which may contain bile). The victim may be restless and prefer to sit and lean forward for pain relief. A person with pancreatitis needs to be hospitalized, because the most effective treatment is to eliminate oral intake for a time (to decrease stimulation of the pancreas). Out of the hospital, allow the victim clear liquids and antacids only, and pain medicine if pills can be kept down. Seek immediate physician care. If a person with severe abdominal pain has blue discoloration around the umbilicus or of the flanks, this may indicate internal bleeding.

RIGHT UPPER QUADRANT

Injured Liver

If a fall or blow to the abdomen, right flank, or right lower chest is followed by abdominal pain that is worsened by pressing on the right upper quadrant, a torn or bruised liver should be considered. The victim is at risk for severe internal bleeding and should be observed for signs of shock (see page 60). Evacuate him as soon as possible.

Hepatitis

See page 224.

Gallstones (Cholelithiasis)

Gallstones are formed in the gallbladder, which lies under the liver in the right upper quadrant of the abdomen. The gallbladder stores bile (manufactured in the liver), which is released into the duodenum to aid in digestion following each meal (Figure 97). An attack of gallbladder inflammation (cholecystitis) occurs when the outlet from the gallbladder or the main bile duct into the duodenum becomes obstructed (usually by a gallstone) and the gallbladder cannot empty. This causes stretching of the gallbladder, inflammation, and painful contraction against an impenetrable passage. There is often an element of infection.

A typical attack occurs immediately after a meal and is sudden in onset. The pain is colicky and located in the right upper quadrant or epigastrium. It may be associated with nausea, vomiting, and fever. Occasionally, it radiates to the back or right shoulder. Examination of the abdomen demonstrates tenderness in the right upper quadrant. Occasionally, you can feel a tennis-ball-sized tender mass—the swollen gallbladder.

The definitive treatment for cholecystitis is removal of the gallbladder, although many surgeons prefer to “quiet down” the situation first with antibiotics, pain medicine, and intravenous fluids. The victim of a gallbladder attack should be transported to a hospital for evaluation. Pain medicines can be given safely, although certain narcotics may increase spasm of the bile passage and, paradoxically, briefly worsen pain. Solid foods (particularly fats) are prohibited during an attack. Maintain the victim on clear liquids and begin antibiotic therapy with ciprofloxacin, ampicillin, amoxicillin, or amoxicillin-clavulanate combined with metronidazole, if pills can be kept down.

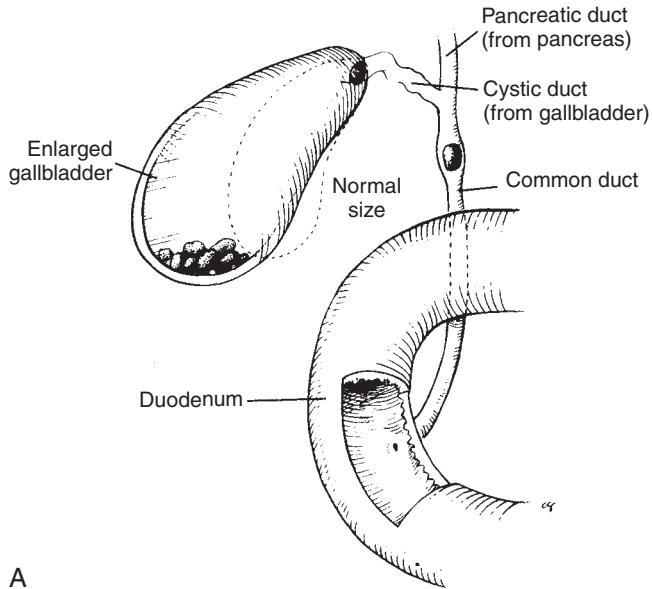
Pneumonia

See page 48.

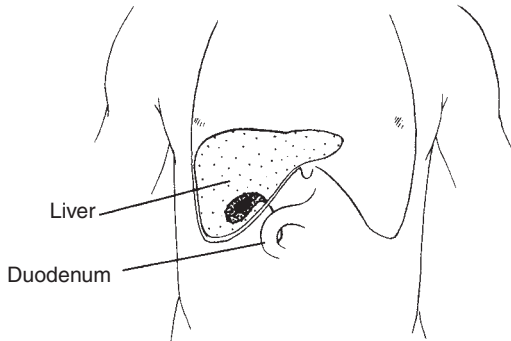
LEFT UPPER QUADRANT

Injured Spleen

If a fall or blow to the abdomen, left flank, or left lower chest is followed by abdominal pain that is worsened by pressing on the left upper quadrant, consider a torn or bruised spleen. The victim is at risk for severe internal bleeding and should be observed for signs of shock (see page 60). Evacuate the victim as soon as possible.



A



B

Figure 97. Gallbladder with gallstones. **A,** The stones are formed in the gallbladder and travel through a narrow passageway (cystic and common ducts), which is easily blocked. **B,** Location of the gallbladder adjacent to the liver in the right upper quadrant of the abdomen.

Gastroenteritis

See page 122.

Pancreatitis

See page 123.

Pneumonia

See page 48.

RIGHT LOWER QUADRANT

Appendicitis

The appendix is a small (average length 9 cm) sausage-shaped outpouching of the cecum (which is a part of the small bowel), with no modern physiological function, that is located near the transition point where the small bowel becomes the large bowel (colon) (Figure 98). When it becomes obstructed or infected/inflamed (acute appendicitis), the victim typically has a history of crampy pain that begins in the central abdomen (often around the umbilicus), and then moves, over the course of a few hours, to become constant in the right lower quadrant. He may also suffer loss of appetite, constipation or diarrhea, vomiting, fever, and weakness. Pain nearly always precedes any other symptoms. There may be burning on urination if the appendix rests against a ureter carrying urine from the kidney to the bladder. Sometimes, if one presses on the left lower quadrant of a victim of appendicitis, there is pain noted in the right lower quadrant. If an inflamed appendix lies close to the obturator or psoas muscles, there may be pain when the right leg is

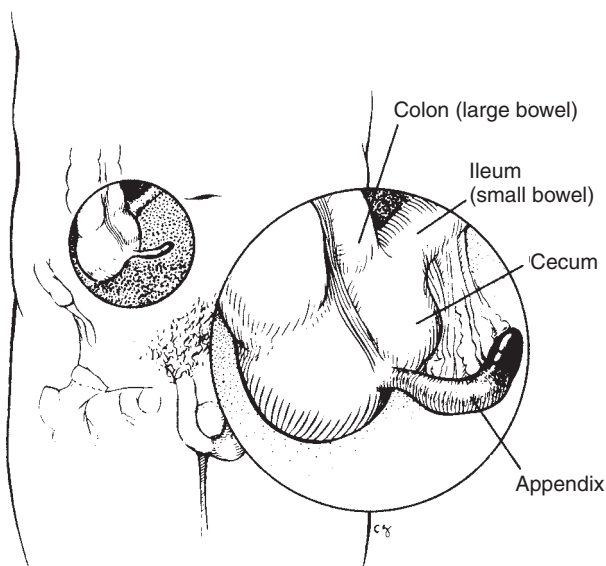


Figure 98. Appendicitis. Pain is felt in the right lower quadrant of the abdomen.

internally rotated (obturator) or pulled away from the midline (psoas) of the body.

Examination of the abdomen demonstrates tenderness in the right lower quadrant. Frequently, the victim will resist any movement of the body or legs, because such movement causes abdominal pain. Rebound tenderness is associated with a swollen appendix that is ready to burst or has already ruptured. After the appendix ruptures, the pain may diminish considerably for a few days while an abscess forms. Untreated appendicitis may cause the victim to develop peritonitis, rapid breathing and heart rate, and low blood pressure. If you suspect appendicitis, transport the victim to a hospital for surgical evaluation. If transport will take more than 24 hours and the victim can tolerate oral fluids (is not actively vomiting), allow clear liquid intake to prevent dehydration. An antibiotic (cephalexin, amoxicillin-clavulanate, cefixime, or cefpodoxime) should be administered if more than 24 hours will elapse before arrival at a hospital. If the victim is allergic to these agents, a combination of ciprofloxacin and metronidazole can be substituted.

If a woman of childbearing age develops right lower quadrant pain, the diagnosis of ectopic pregnancy (see page 133) should always be considered. It is useful to carry a “home” urine pregnancy test kit in the first-aid kit.

Kidney Stone

See page 135.

Ovarian Infection (and Other Disorders of the Female Reproductive System)

See page 131.

Colitis

See page 218.

Bowel Obstruction

If the intestine becomes obstructed by scar tissue, cancer, injury, or feces, the victim rapidly becomes quite ill. Symptoms include nausea and vomiting, frequently of green bile or feculent (feces-like) material. The victim has waves of cramping pain associated with waves of bowel motion (contractions) that may be visible through the abdominal wall, which is often distended by the dilated loops of bowel. Occasionally, the victim will have small, squirting

bowel movements, as a little liquid slips past the obstruction. If a bowel obstruction is suspected, the victim should be immediately evacuated to a hospital.

An ileus is functional inactivity (no food or fluid absorption, lack of normal peristalsis) of the bowel that leads to intestinal dilation, vomiting, and abdominal pain. It commonly follows an intraabdominal injury or physiological catastrophe (such as extensive burns, disseminated infection, or shock).

Hernia

If the intestine slips through the muscles of the abdominal wall, usually in the groin or around the umbilicus (navel), a hernia is formed (Figure 99). Symptoms include a visible bulge, abdominal pain, and pain at the site of the hernia. The victim should be made to lie quietly on his back with his knees drawn up; place cold packs directly on the bulge. Give pain medicine to control the discomfort. If sufficient relaxation is obtained, the hernia may slip back through the wall, and the bulge will disappear. Afterward, the victim should wear a support (truss or belt) to prevent recurrence until the problem can be corrected surgically. Straining and heavy lifting should be avoided.

If a victim has a painless hernia (bulge) that cannot be corrected, he should avoid straining, particularly when holding his breath, and seek the advice of a physician.

If the intestine will not slip back through, the hernia is trapped (incarcerated). This is an emergency, because if the blood supply to the bowel is pinched off, the tissue can be severely damaged or die, and/or a bowel obstruction (see page 127)

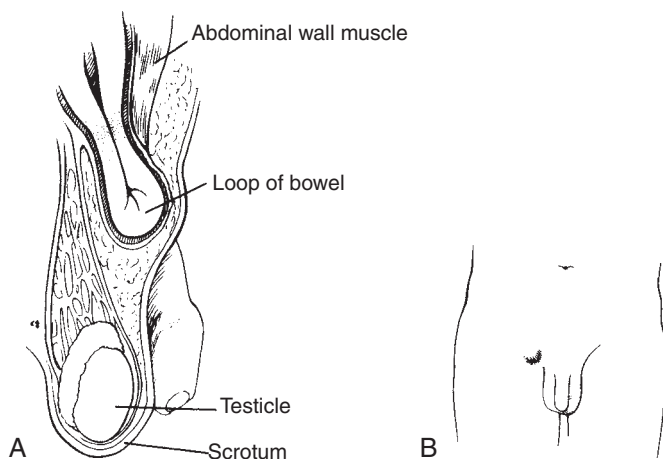


Figure 99. Inguinal (groin) hernia. **A**, A loop of bowel bulges through a defect in the lower abdominal wall. **B**, Location of external bulge. In some cases, the swelling extends into the scrotum.

can be created. An incarcerated hernia is extremely painful, and if the bowel is injured, the overlying skin frequently becomes reddened or dusky in appearance. Because the aforementioned maneuvers for reduction of a hernia will not be successful and pain will increase, the victim should be rapidly evacuated to a hospital.

LEFT LOWER QUADRANT

Diverticulitis

Diverticula are small outpouchings that develop at weak points along the wall of the colon (large bowel), probably because of high pressures associated with muscle contractions during the passage of stool. When these sacs become obstructed and/or inflamed (most frequently in middle-aged or elderly individuals), they enlarge and create pain and fever. Usually, the left lower quadrant is involved, because diverticula tend to form in the left-side portion of the colon (descending colon) more frequently than in the right-side portion (ascending colon) or horizontal connecting section (transverse colon). A ruptured diverticulum can cause a clinical picture much like that of a ruptured appendix (see page 126), with pain in the left side of the abdomen instead of the right side. The victim should seek medical attention, and his diet should be limited to clear fluids. Antibiotics (metronidazole, metronidazole combined with doxycycline, amoxicillin-clavulanate, trimethoprim-sulfamethoxazole, cefixime, ciprofloxacin, or cefpodoxime) should be administered if help is more than 24 hours away.

Colitis

See page 218.

Kidney Stone

See page 135.

Ovarian Infection (and Other Disorders of the Female Reproductive System)

See page 131.

Bowel Obstruction

See page 127.

Hernia

See page 128.

LOWER ABDOMEN (CENTRAL)

Abdominal Aortic Aneurysm

An aneurysm is a dilated blood vessel that has been weakened by the ravages of age, high blood pressure, and atherosclerosis (Figure 100). At a certain point, the wear and tear become too much and the blood vessel rips, causing either a slow leak or rapid, massive bleeding that leads to sudden collapse and death. This generally occurs spontaneously only in the elderly, unless there is a congenital defect; traumatic tears of the aorta occur in all age groups.

The aorta is the large artery that carries blood from the left ventricle of the heart to the body. The symptoms of a ruptured abdominal aortic aneurysm are intense, unrelenting, ripping pain in the abdomen that may radiate to the back or chest; weakness; discoloration of the legs with mottling; and rapid collapse. Gentle examination of the abdomen may demonstrate a pulsating, expanding mass. Abdominal rigidity is due to the rapid accumulation of blood.

Any elderly person who suddenly develops abdominal pain or back pain associated with weakness, a fainting spell, decreased sensation and/or abnormal color in the legs or feet (even if transient) or shortness of breath should be immediately rushed to a

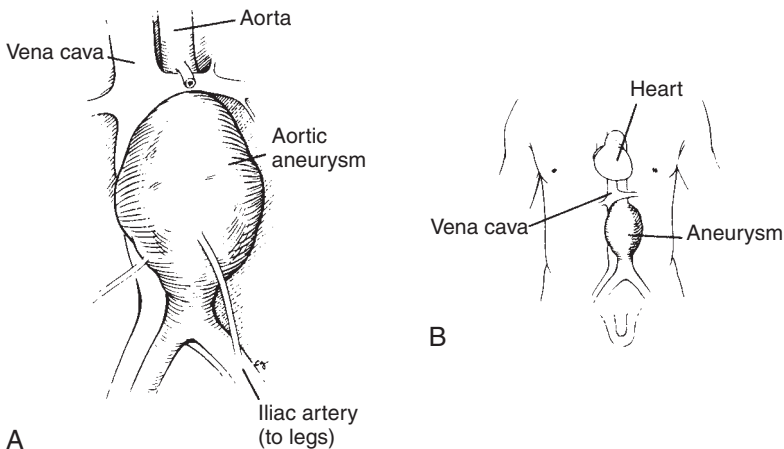


Figure 100. Abdominal aortic aneurysm. **A**, Age, high blood pressure, and disease ravage the dilated aorta. **B**, Location of the aorta in the abdomen. Leaking or rupture causes pain in the abdomen, back, and flank.

hospital. In the best of circumstances, this is a highly critical situation. Be prepared to treat the victim for shock (see page 60).

Ovarian Infection

The ovaries and fallopian tubes (Figures 101 and 102), which carry eggs from the ovaries to the uterus, may become infected, commonly with the bacteria that cause gonorrhea (a form of venereal disease) or by other infectious agents, such as *Chlamydia trachomatis*. Symptoms include abdominal pain in the lower quadrants (greatest on the side of the affected ovary), fever, shaking, chills, nausea, vomiting, and weakness. Occasionally, the victim will complain of a yellow-greenish vaginal discharge. If you suspect an infection, take the victim to a hospital immediately. If more than 24 hours will pass before a doctor can be reached, the victim should be started on tetracycline 500 mg four times a day, amoxicillin-clavulanate 500 mg 2 to 3 times per day, or doxycycline 100 mg two times a day, for 14 days (doxycycline and tetracycline are effective against *Chlamydia*). Azithromycin 1 g in a single dose is also effective against chlamydial infection. If you suspect gonorrhea, administer cefixime 400 mg orally twice a day (for single-dose therapies for gonorrhea, see page 299). To treat gonorrhea and chlamydial infection at the same time (the two germs often “travel” together), administer azithromycin in a 2 g single dose (again, see page 299). If the victim is pregnant or allergic to penicillin and gonorrhea is suspected, administer azithromycin 2 g in a single dose or erythromycin base 250 mg four times a day for 14 days. Another treatment regimen that may be used is ofloxacin 400 mg twice a day or levofloxacin 500 mg once a twice for 14 days, either of these with the addition of metronidazole 500 mg twice a day for 14 days, noting that this regimen may be less effective than the others noted because of bacterial resistance to fluoroquinolone drugs.

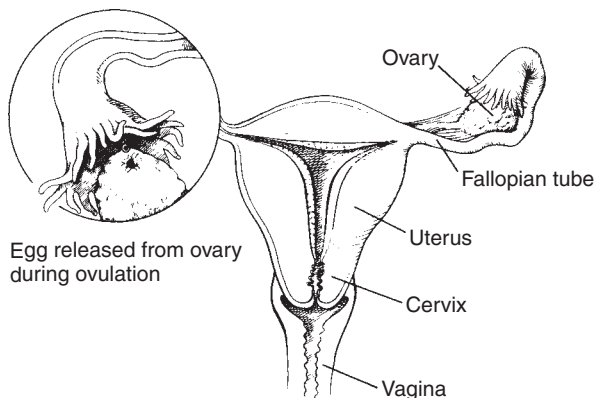


Figure 101. Female reproductive tract.

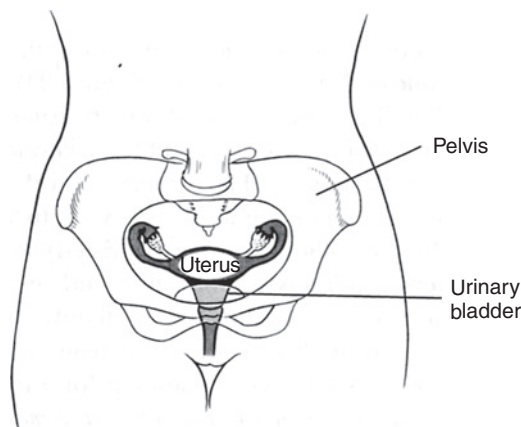


Figure 102. Location of female reproductive tract within the pelvis.

Ovulation, Ovarian Cyst, and Torsed (Twisted) Ovary

Some women suffer sudden, intense abdominal pain at the time of ovulation (when the egg is released from the ovary) (see Figure 101). This is caused by a small amount of blood and ovarian fluid, which irritates the lining of the abdomen. Symptoms include pain that suddenly develops in the right or left lower quadrant, and is worsened by movement or deep palpation of the area. Treatment is pain medicine and rest. A ruptured ovarian cyst (which releases tissue fluid or blood) or torsed (twisted) ovary causes similar but much more severe symptoms, which may include excruciating pain, nausea and vomiting, and a rigid (to the pressing hand) abdomen. Any of these conditions may be difficult to distinguish from appendicitis (see page 126) if the right ovary is involved. Treatment for a torsed ovary may require surgery. *Any sudden abdominal discomfort in a woman of childbearing age should be promptly evaluated by a physician.*

Bleeding from the Vagina

If bleeding from the vagina accompanied by abdominal pain is not clearly part of a normal menstrual period, a woman should seek prompt medical attention. If the bleeding is clearly part of a normal menstrual period, and the pain is unquestionably due to menstrual cramps, the victim may benefit from the administration of a nonsteroidal antiinflammatory drug.

If abnormal (in amount or character) pain and/or bleeding occurs during or between menstrual periods, the cause should be determined by a physician.

Until the evaluation is performed, exertion should be kept to a minimum. If periods have been missed (or if the victim is known to be pregnant) and copious vaginal bleeding develops, place the victim at rest and transport her rapidly—by litter, if possible—to a physician. If the bleeding is spotty, the victim may walk with assistance. A ruptured tubal (ectopic) pregnancy can rapidly become life threatening. In this situation, a pregnancy situated in a fallopian tube (rather than in the uterus) causes the tube to rupture. The symptoms include vaginal bleeding, lower abdominal pain (which can become severe), and signs of shock (see page 60). This is a true medical emergency.

Vaginitis, Vaginal Discharge, and Vaginal Infections

The most common causes of female genital tract discharge are infection, reaction to a foreign object, injury, or allergic reaction. In the healthy vagina, bacteria (lactobacilli) produce lactic acid and promote an environment (pH of 3.8 to 4.5) that resists infection, although there are other microorganisms (such as *Staphylococcus*, *Ureaplasma*, and *Mycoplasma*) present.

Vaginitis is a condition of irritation and inflammation of the vagina, commonly noted as a secondary condition that follows administration of an antibiotic, such as ampicillin, to a woman. The antibiotic alters the normal bacterial population of the vagina and allows overgrowth of the causative (for vaginitis) agent, which is often yeast. With a *Candida albicans* yeast (candidiasis or moniliasis) infection, the victim notes a thick, white, and creamy or curdy (“cottage cheese”) discharge, vulvar and vaginal itching and redness, and burning pain on urination. She should use clotrimazole (Gyne-Lotrimin). Administer vaginal 100 mg tablets once a day for 7 days, or twice a day for 3 days; a vaginal 500 mg tablet for 1 day (single dose); or 1% cream in a 5 g dose for 7 to 14 days. An alternative drug is miconazole nitrate (Monistat); administer 100 mg vaginal suppositories once a day for 7 days, 200 mg vaginal suppositories once a day for 3 days, 1,200 mg vaginal suppository in one dose, or 2% cream in a 5 g dose for 7 days. Other acceptable treatments are a single fluconazole (Diflucan) 150 mg tablet by mouth; tioconazole 6.5% (Vagistat-1) ointment in a single 5 g application; butoconazole nitrate 2% (Femstat) cream in a 5 g dose for 3 days; and terconazole (Terazol) vaginal cream 0.8% in a 5 g dose once a day for 3 days, vaginal cream 0.4% in a 5 g dose once a day for 7 days, or vaginal suppositories 80 mg once a day for 3 days.

Bacterial vaginosis is caused by a shift in vaginal bacterial flora from lactobacilli-dominant to mixed flora, and is characterized by a milky (white or gray), sticky, homogeneous, and sometimes thin discharge with an abnormal (“fishy,” particularly after intercourse) odor, as well as occasional itching and pain. It is definitively diagnosed by measuring the vaginal pH at a value greater than 4.5 and noting a specific type of cell (“clue cell”) when the discharge is

examined with a microscope. Treatment is either metronidazole 500 mg by mouth twice a day for 7 days or 0.5% or 0.75% metronidazole vaginal gel (such as MetroGel-Vaginal) once a day for 5 days; or clindamycin phosphate 300 mg by mouth twice a day or 1 applicator (5 g) of 2% vaginal cream at bedtime for 7 consecutive nights; or 2% extended-release clindamycin cream, one application intravaginally.

If the infection is due to trichomoniasis (caused by *Trichomonas vaginalis*), the victim will suffer a copious, occasionally frothy, and white-gray or yellowish discharge and may also have abdominal pain and fever. In such a case, the antibiotic of choice is tinidazole 2 g in a single dose, metronidazole 2 g in a single dose, or metronidazole 250 mg three times a day, or 375 mg two times a day, for 7 days. Do not drink alcohol while taking tinidazole or metronidazole or for 3 days thereafter. The male sex partner should be treated with tinidazole or metronidazole 2 g in a single dose.

On return to civilization, an appropriate gynecological exam should be sought to exclude other causes of vaginal infection, which include herpes simplex virus, *Neisseria gonorrhoeae* (the causative agent of gonorrhea), and *Chlamydia trachomatis*.

Genital herpes is caused by herpes simplex virus type 1 (HSV-1) or type 2 (HSV-2). HSV-1 is transmitted predominantly by oral-genital sexual contact and HSV-2 by genital-genital contact. After exposure, the incubation period is 2 to 12 days, with an average of 4 days. Early symptoms include a red rash and small bumps, followed by a blistering rash with ulcers. Other symptoms may include pain at the site of the rash, tender local lymph nodes, fever, headache, fatigue, and muscle aching. If the blisters and ulcers occur on external skin, they heal in 9 to 12 days after a crusting phase; if they occur on mucous membranes (e.g., inside the vagina or the mouth), they heal without first crusting. After the first episode of genital herpes has resolved, recurrent episodes may be preceded by tingling or sharp pain in the buttocks, legs, or hips from a half hour to 5 days before the rash erupts. Antiviral treatment can shorten the first episode or a recurrent episode, or can be used to suppress the onset of an eruption. The following are recommended doses of medications:

For first episode of genital herpes (take medication by mouth for 7 to 10 days):

acyclovir 200 mg 5 times a day or 400 mg 3 times a day; or valacyclovir 1 g twice a day; or famciclovir 250 mg 3 times a day.

For recurrent episode of genital herpes (take medication by mouth for

5 days): acyclovir 200 mg 5 times a day or 800 mg twice a day; or valacyclovir 500 mg twice daily or 1 g once a day; or famciclovir 125 mg twice a day.

For suppressive therapy against genital herpes (take medication twice a day for as long as suppression is desired: acyclovir 400 mg; or valacyclovir 500 mg; or famciclovir 250 mg. It is possible that taking any of these medications once a day, rather than twice a day, may be effective.

Emergency Contraception

In the event that emergency contraception is desired (e.g., for unprotected sexual intercourse or contraceptive failure), levonorgestrel tablets 0.75 mg (Plan B) are available over-the-counter and approved for women age 18 years and older. A prescription is required for a woman age 17 years or younger. This medication does not protect against infection with human immunodeficiency virus (HIV) and other sexually transmitted diseases. The medication provides a short burst of hormones that affects the lining of the uterus and alters sperm transport, which prevents sperm from meeting the egg to achieve fertilization. Levonorgestrel is effective if given within 5 days (120 hours) of intercourse, but is most effective if given within the first 24 hours after intercourse. The dose is one pill by mouth, followed by a second pill 12 hours after the initial pill.

Bladder Infection

See page 294.

Colitis

See page 218.

Bowel Obstruction

See page 127.

FLANK

Abdominal Aortic Aneurysm

See page 130.

Kidney Stone

A “kidney stone” originates in the urine-collecting system of the kidney, and most commonly causes pain when it travels down the ureter (ureteral stone) to the bladder (Figure 103). After traversing the bladder, it may enter the urethra and continue to wreak havoc. The most common compositions of stones are calcium-derived (80%), struvite (15% to 20%; magnesium ammonium phosphate), uric acid (5% to 10%), and cysteine (less than 1%).

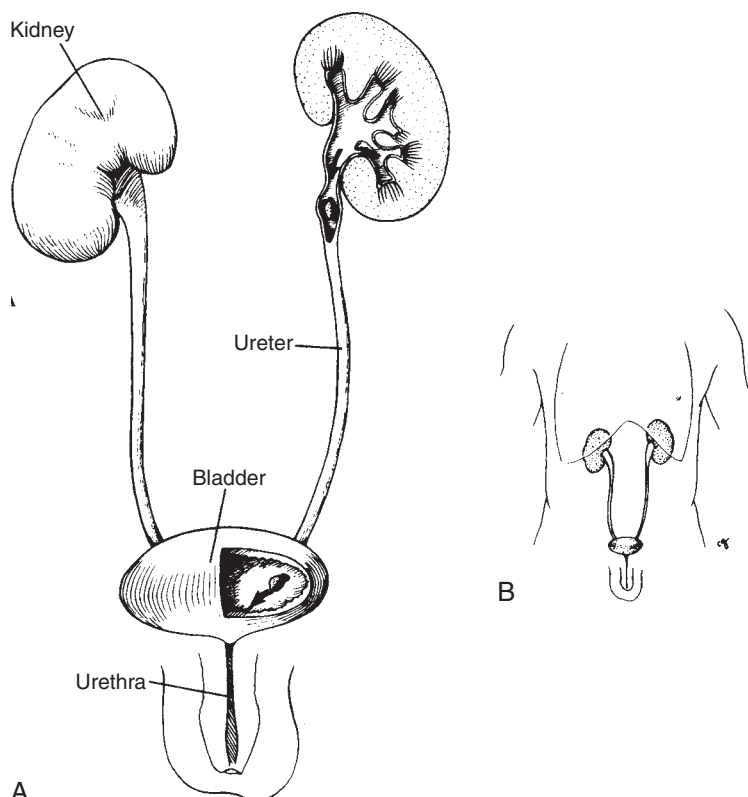
**A**

Figure 103. Kidney with kidney stones. **A**, The stones are formed in the kidney and travel through the ureter, bladder, and urethra before they are passed in the urine. **B**, Location of the genitourinary (urogenital) system.

The pain of a kidney stone is usually sudden in onset and often becomes intolerable. The location of the pain is related to the location of the stone. If the stone is high in the ureter, the pain localizes to the victim's back (on the affected side), with some radiation to the abdomen. Lightly tapping over the flank and lower ribs on the back of a victim with a kidney stone will often cause extreme pain. If the stone is passing through the lower ureter, the victim will have extreme pain in the back, abdomen, and genitals. When the stone is not moving, the pain (renal "colic") may disappear as quickly as it began. A small (less than or equal to 2 mm in diameter) stone may take 7 to 10 days to pass; a 2 to 4 mm stone may take up to 2 weeks; and a stone larger than 4 mm may take up to 3 weeks.

A victim who is passing a kidney stone finds no relief from remaining motionless, and will appear quite agitated, constantly changing positions. Associated symptoms include nausea, vomiting, bloody urine, an urge to urinate, pain on urination, and sweating.

If the diagnosis of a kidney stone appears relatively certain, give the victim the strongest pain medicine that is necessary and available, and encourage him to drink copious amounts of fluid. Ketorolac (10 mg by mouth every 4 to 6 hours, not to exceed 5 days) has been recommended as a pain medication for kidney stone because it may decrease spasm in the ureter; it may be given along with a narcotic drug, such as hydrocodone, to enhance the analgesic effect. Another useful drug if ketorolac is not available is diclofenac 50 mg by mouth 2 or 3 times a day. Some urologists recommend adding tamsulosin (Flomax) 0.4 mg by mouth once a day for a few days after the onset of pain associated with passing a kidney (ureteral) stone. Seek physician evaluation as soon as possible. *If the victim is elderly, consider the diagnosis of ruptured aortic aneurysm* (see page 130). If you have any suspicion that the victim might have an aneurysm, evacuate him immediately.

Kidney Infection

See page 295.

Pneumonia

See page 48.



When a woman is ready to give birth, the contractions of labor are usually intense and uninterrupted, or separated by intervals of less than 3 to 5 minutes. If the child to be born is not the woman's first, labor can progress very quickly, so don't wait until the last minute to set up. On the other hand, don't deliver a baby in the woods if it isn't necessary. If the child is the mother's first, if the contractions are more than 5 minutes apart, if the waters have not "broken" (a gush of fluid from the ruptured amniotic sac) and there has been no passage of bloody mucus, and if no bulging is present in the vaginal area, consider whether you have time to make it to the hospital. If the waters have broken and labor has not

begun, it is best to evacuate the mother, because delivery must occur or be induced within 24 hours to avoid the onset of an infection that could jeopardize the infant and mother. *If the umbilical cord or any other part of the infant other than the head is showing at the vagina, the delivery will be difficult and should be performed if at all possible by a skilled obstetrician.*

If delivery is imminent (the mother wishes to push) and you are outdoors, spread a towel or blanket. The birthing process is fairly messy, so don't expect to salvage the ground cloth. Wear sterile latex rubber gloves from your first-aid kit. If you are allergic to latex, use other nonpermeable gloves (such as nonlatex synthetic). If you don't have gloves, wash your hands with soap and water. Have the following supplies ready: four towels for drapes; two sturdy strings to tie the umbilical cord; a sharp pair of scissors, scalpel, or knife to cut the umbilical cord; a towel to dry the baby; a blanket to wrap the baby; a rubber suction bulb for the baby's mouth and nose; and a large plastic bag to carry the placenta.

Have the mother undress below the waist and cover her with a blanket or sheet. She should lie on her side between contractions until she feels that she is ready to push. When she wants to push, have her lie on her back with her legs spread as far apart as possible. Place a towel (drape) over each thigh, across the abdomen, and under the buttocks to "frame" the vagina.

It is extremely helpful to elevate the buttocks with a folded blanket or pile of towels. This is because the most difficult part of a normal birth is delivery of the upper shoulder, which is facilitated by pushing the infant downward at the proper time.

When the mother is undergoing a contraction, and you see some wrinkled skin and a wisp of hair from the infant's head showing in her vagina, have the mother grab behind her legs and pull them up toward her head, or plant her feet firmly, while she bears down (like having a bowel movement) and pushes. This may go on while the vaginal entrance stretches to accommodate the infant's head. If the fluid-filled, transparent amniotic sac is bulging out in front of the infant's head, it can be nicked with a sharp blade or scissors to allow the fluid to be released and the delivery to proceed. Do not do this unless you are absolutely certain that the childbirth will occur away from a hospital. A mother may prefer to squat during delivery, but this makes assisting her more awkward.

During a push, put one hand gently on the infant's head and another underneath his head, providing countertraction against the woman's perineum (the area between the anus and the vaginal opening) to allow gradual stretching of the opening and to then assist delivery of the head and control the speed of delivery. You do not want the head to "pop out," to avoid a large tear in the vagina.

A baby is delivered in (ideally) two stages. First, the head and face appear, usually with the face down (Figure 104). Once the infant has appeared to the level of his eyebrows, instruct the mother to stop pushing. The baby will be extremely slippery. When his face appears, run your fingers around the infant's neck to see if the umbilical cord is wrapped around it. If it is, see if you can slip it over the head. If not, tie (clamp) it off tightly twice, with about 1½ in

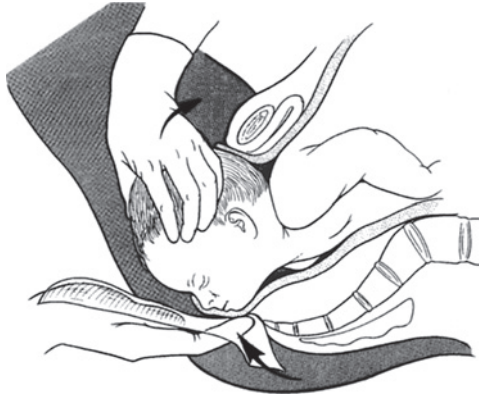


Figure 104. Appearance of the head and face during childbirth.

(3.8 cm) between ties, and cut carefully between the ties. The ties must be tight and not slip off, or the baby could suffer severe bleeding.

In the moment between the delivery of the head and the beginning of the shoulders' emergence, support the head with one hand and gently wipe the face with a clean cloth. Gently suction the nose, using the bulb syringe, by squeezing the air out, placing the tip in each nostril, and letting the bulb inflate. Squirt out any extracted material before each insertion of the tip. Suction each nostril at least twice, and then suction out the mouth. If a device for suction isn't available, wipe out as much amniotic fluid as you can with a finger, tissue, or cloth.

The baby's head and body will spontaneously rotate 90 degrees (don't twist them) to one side as the body starts to emerge. Have the mother resume pushing. While supporting the head, grasp the uppermost (with respect to the ground) shoulder and apply gentle downward pressure until the upper shoulder is delivered from the vagina (Figure 105). Don't tug on the head or pull from underneath the infant's armpits. After the upper shoulder is out, exert gentle upward pressure to free the lower shoulder (Figure 106). At this point, be prepared to hang on tight, because the rest of the baby will shoot out, usually with a big gush of amniotic fluid and some blood.

Hold the baby in a towel or blanket and dry him. Hold him firmly by the ankles, but don't dangle him upside down. If you have not already done so, tie (clamp) the umbilical cord with two ties (preferably sterile—dipped in boiling water, for example), one at 6 in (15 cm) and one at 8 in (20 cm) from the child. Use cord that won't slip a knot, shoelace material, or cotton tape. Cut carefully between the ties. Suction the baby's mouth and nose (newborns are nose breathers) again, and stimulate him by rubbing with a towel until he begins to cry. Gently wipe off all the residual slimy material. Wrap the child in a blanket and hand him to the mother to hold. The mother may begin to breast-feed at this point.

The long end of the umbilical cord, which is still attached to the placenta that is attached to the inside wall of the uterus, will be hanging from the mother's vagina. The placenta will deliver spontaneously, so do not pull on the umbilical

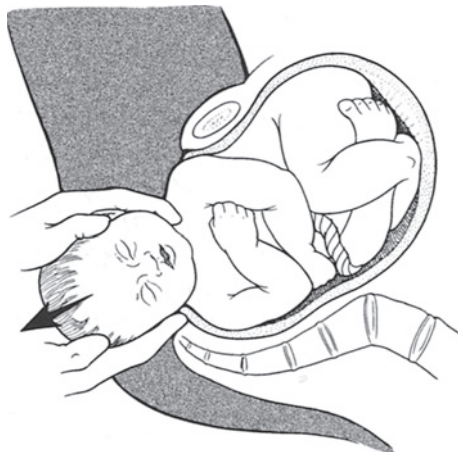


Figure 105. Gentle downward pressure to deliver upper shoulder.



Figure 106. Gentle upward pressure to deliver lower shoulder.

cord. *Do not massage the mother's abdomen (uterus) until after the placenta is delivered.* Place the placenta in a plastic bag and bring it to civilization for inspection. After the placenta is delivered, gently massage the mother's abdomen for 30 minutes. This stimulates the uterus to contract and helps control bleeding. It will feel like a firm, rounded, grapefruit-sized mass in the middle of the lower abdomen just above the pubic bone. If bleeding starts again, massage more vigorously. You may have to repeat this a few times during the hours immediately following childbirth. It may be uncomfortable for the mother.

If bleeding seems profuse after the placenta is delivered, or if the placenta does not spontaneously deliver after 60 minutes, be prepared to treat for shock (see page 60).

If the vagina is torn, apply pressure with a sterile compress. After the bleeding slows, the vaginal area can be gently washed, with the mother on her back, so that rinse water flows away from the vagina toward the anus. Take care to keep any contaminating material or solutions out of the vagina. Lay a sterile compress or clean sanitary napkin over the vagina.

After a wilderness birth, administer an antibiotic (cephalexin, amoxicillin-clavulanate, or erythromycin) to the mother for 48 hours.

COMPLICATED DELIVERIES

Breech Delivery

In a breech delivery, the infant's buttocks and legs come out first. Let him deliver spontaneously (do not pull) until the level of his umbilicus (where the umbilical cord attaches) appears. At this point, take a firm hold on the baby's pelvis and apply gentle traction. Do not pull on his legs or back.

Determine which shoulder is lower, and try to swing the baby's body to the other side to allow that shoulder to exit the vagina. Gently move him to the opposite side to deliver the other shoulder. Don't let go of the baby. If the first shoulder won't deliver, you may need to reach inside the vagina with two fingers to locate one of the infant's arms and swing it down across his anterior chest, so that the hand and forearm are delivered. Repeat this procedure for the second arm.

Position the baby so that his face is down. With one hand tightly holding the baby by his ankles, slide your other hand underneath him and slip your middle finger into the vagina, then into the baby's mouth for a grip. During a contraction, when the mother is pushing, extract the baby. If the extraction takes a few minutes, let the baby rest on your forearm with your finger in his mouth and his arms and legs dangling on either side, and use your other hand to push the vaginal tissues away from his face.

Prolapsed Umbilical Cord; Single Arm or Foot

A prolapsed umbilical cord occurs when the cord falls out of the vagina and becomes trapped between the baby and the opening. This can be a catastrophe, because if the cord is pinched and obstructed, the blood supply to the baby will be interrupted.

Turn the mother on her side or have her kneel in the knee-to-chest position and try to interrupt labor. Do not encourage pushing. Place a moistened (with disinfected saline, preferably) towel over the cord and vagina and expedite an emergency evacuation of the mother from the wilderness. If the delivery continues, try to have it occur without undue delay. Do your best to keep the head from compressing the cord.

If a single arm or foot hangs out of the vagina, have the mother kneel in the knee-to-chest position and try to get her to a hospital as quickly as possible.



DIABETES

Diabetes mellitus is a disorder in which the pancreas cannot create sufficient insulin (type 1 or insulin-dependent diabetes) or in which insulin is not effective (type 2 or non-insulin-dependent diabetes). Insulin allows the body to use and store sugar; in the diabetic state, the victim suffers from high blood sugar and an array of physiological derangements (kidney failure, skin ulcers, bleeding into the vitreous of the eye) associated with deterioration of small blood vessels. Many diabetics need to take insulin by injection or inhalation to manage the disease; others can control their blood sugar by diet, oral medications (hypoglycemic agents), or both. Oral medications include drugs that stimulate pancreatic cells to produce more insulin (e.g., glipizide [Glucotrol]), reduce sugar production in the liver (e.g., metformin [Glucophage]), reduce carbohydrate absorption and sugar “peaks” after eating (e.g., acarbose [Precose]), or reduce insulin resistance in the body (e.g., pioglitazone). Exenatide (Byetta) injection is used as a supplemental drug for certain patients with type 2 diabetes. Insulin analogues, such as insulin lispro, are rapidly acting and when used in conjunction with standard insulins, which have longer onset and duration of action, can allow the outdoor enthusiast who suffers from diabetes to have greater flexibility in the timing of meals, snacks, and exercise. One product is the Humalog KwikPen. Insulin is available in an inhaled form (Exubera).

The most common dangerous acute situation incurred by a diabetic is a hypoglycemic reaction (low blood sugar) induced by an inadvertent overdose of insulin, or after a normal dose of insulin or glucose-lowering agent accompanied by extraordinary exercise or insufficient food intake. The manifestations of an insulin reaction are weakness, sweating, hunger, abdominal pain, and altered mental status (which may include confusion, belligerent behavior, fainting, seizures, or coma). The solution is to administer sugar as rapidly as possible. If the victim is unconscious, it is generally prohibited to administer anything by mouth, because of the danger of choking and aspiration of food or fluid into the lungs. However, sugar granules or concentrated liquid glucose

(Glucose: one tube contains 25 g) can be inserted under the tongue, to dissolve and be passively swallowed. Otherwise, sterile glucose solution must be injected intravenously, which obviously requires a trained individual. If the victim is awake and capable of swallowing, a naturally sweetened solution (apple or orange juice, sugar-containing soft drink), banana, or candy bar (chocolate, sugar cube) should be eaten. As soon as the victim feels better, he should eat a meal, to avoid a recurrence.

Glucagon is a hormone that causes the liver to release glucose. In a hypoglycemic emergency, it can be administered into the muscle of the victim to raise the blood glucose level. Here are the steps for administration:

1. Find the diabetic person's glucagon injection kit (GlucaGen HypoKit), most likely stored in a small zippered case. There will be powder and vials of liquid (GlucaGen) and capped or wrapped syringes inside.
2. Put 1 mg of the included powder into a vial of GlucaGen.
3. Roll the vial back and forth quickly between your palms until the powder is dissolved.
4. Take out a syringe and remove the cap. Push the plunger all the way down.
5. Plunge the needle through the rubber cap of the vial and draw the liquid into the syringe. Pull the syringe and needle out.
6. Point the needle and syringe up so that the air floats to the top of the syringe just under where the needle attaches to the syringe (see page 474). Push the plunger gently until a few drops of liquid drip out to be sure that there is no air in the needle.
7. Stab the needle all the way into a muscular area such as the curve of the calf or into a muscular thigh. Try not to push it into fatty tissue, such as a buttock. While holding the needle and syringe motionless, pull back on the plunger to be sure that the needle is not positioned in an artery or vein, in which case blood would freely enter the barrel of the syringe. If no blood is returned, then push the plunger all the way down without any hesitation. Do not administer the glucagon injection directly into a vein.
8. When the person revives, give him some kind of simple sugar (Glucose paste, glucose tablets, fruit juice, or hard candy), so long as he is capable of purposeful swallowing. Expect the blood glucose level to remain adequate for an hour or so because of the injection, so it is important to observe the person closely and be sure that he continues to ingest food and liquid.

It is important that anyone who suffers from diabetes wear appropriate identification, in case he requires assistance. No one who is insulin dependent should attempt physical exertion in a dangerous environment without adequate glucose intake. Even a person taking an oral hypoglycemic drug, such as micronized glyburide or glipizide, should be similarly cautious.

If the blood sugar gets dangerously high, the diabetic may become very ill, because the blood becomes acidotic with the by-products of metabolism

(known as ketones), dehydration increases, and body chemistries become unbalanced. Such a patient is confused, combative, or comatose. His breathing rate increases, breathing becomes shallow, and exhaled breaths have a fruity or acetone (like fingernail polish remover) odor. Because of dehydration, the skin is very dry and there is little sweating (dry armpits). Such a clinical picture calls for immediate transport of the victim to the hospital. If he can drink, he should be encouraged to ingest unsweetened fluids. The definitive treatment for ketoacidosis is intravenous fluids and insulin injections, which must be carefully dosed according to the measured blood sugar level.

If you cannot differentiate between an insulin reaction (low blood sugar) and altered mental status caused by excessively high blood sugar, you should err on the side of predicting a hypoglycemic episode and give the victim something sweet to eat or drink. If you have guessed correctly, the improvement will be dramatic; if your diagnosis was wrong, the extra sugar will not cause any significant harm. If a diabetic person is carrying a blood glucose monitor (such as FreeStyle Lite, FastTake, Accu-Chek, or SureStep), be sure you are instructed in its proper use before you need to use it.

If a person with diabetes develops a skin infection, particularly if it is on the foot, an appropriate antibiotic choice is dicloxacillin, amoxicillin-clavulanate, or ciprofloxacin.



STROKE

A stroke is caused by a blood clot that blocks an artery supplying part of the brain, or by bleeding from a leaking vessel into the brain. It occurs suddenly and can be minor or major, depending on the area and amount of the brain involved. If a stroke involves the brainstem, it may affect the breathing center and cause rapid death. A stroke may be caused by rupture of a cerebral artery aneurysm; when this occurs, the victim may suffer from a form of bleeding known as subarachnoid hemorrhage, in which case the victim typically complains of the “worst headache of my life.”

Symptoms include sudden headache without another cause; numbness of the face, arm, or leg; nausea and vomiting; blurred or double vision; weakness or paralysis of the arm(s) and/or leg(s) (particularly if it occurs on one side);

difficulty speaking or understanding speech; difficulty walking; dizziness, confusion, and/or loss of balance or coordination; loss of consciousness; coma; seizure; and collapse. If someone has stroke symptoms that last for a few minutes to an hour and then gradually resolve, he has suffered a transient ischemic attack (TIA), which is a warning that he may soon suffer a full-blown stroke. Even if stroke symptoms are fleeting, the victim should see a physician as soon as possible. If a person is believed to have suffered a TIA, he should begin to take aspirin, 50 to 325 mg by mouth once a day, until he is evaluated by a neurologist. If a stroke occurs, aspirin should not be administered.

A rapid simple neurologic examination may reveal subtle changes indicative of a stroke. This exam consists of the following:

Mental status. Ask the victim his name, age, and location, as well as time, day, and year.

Vision. Have the victim count fingers that you display. Check each eye by itself and then both eyes together. Check that the pupils are equal. Ask the victim to follow a moving object with his eyes.

Facial muscles. Ask the victim to pucker his lips, and then to whistle. Check the cheeks and mouth for symmetry. Have the victim clench his jaw while you feel the jaw muscles on each side. Have the victim tightly close his eyes. Have him relax with his eyes closed; lightly touch his face to locate any numb spots.

Hearing. Make a soft noise (yet loud enough that you can hear it) in each of the victim's ears.

Swallowing and speech. Ask the victim to swallow. Ask him to stick his tongue out and move it from side to side voluntarily. Listen carefully to note if his speech is clear or slurred.

Muscle strength. Have the victim squeeze one of your fingers with each hand, straighten each leg against resistance, bend each leg against resistance, bend and straighten each elbow and wrist against resistance, extend and flex each ankle against resistance, and shrug both shoulders against resistance.

Sensation. Using a light touch, move your fingers over the entire body and try to identify any areas of decreased sensation.

Coordination. Ask the victim to stand perfectly still in an upright position with his eyes closed and his arms at his sides. Be prepared to catch him if he begins to fall. Have him open his eyes, and then clap one hand into the palm of the other as fast as possible. Ask him to move an index finger back and forth between the tip of his nose and your finger, held 18 in (46 cm) away. Have him walk heel-to-toe and on tiptoes.

If someone displays the symptoms of a stroke, he should be placed at absolute rest with his upper body and head elevated by an angle of at least 30 degrees. If his level of consciousness declines, pay attention to his airway (see page 22) so that he does not vomit and choke. Seek immediate medical attention. Low blood sugar may cause symptoms that mimic a stroke. If the victim can swallow purposefully without choking, sugar granules or concentrated liquid glucose

(Glucose: one tube contains 25 g) can be inserted under the tongue, to dissolve and be passively swallowed (see page 142).

If stroke symptoms are associated with scuba diving, they might indicate an air embolism (see page 401). In this case, the victim needs to be transported in a head-up and/or left-side-down position and delivered to a recompression (hyperbaric) chamber as soon as possible.



INFECTIOUS DISEASES

Foreign travel is increasingly a component of the wilderness experience, and thus American travelers are exposed to numerous diseases that are not indigenous to the United States. In addition, domestic outdoor activities expose us to the vectors (carriers, such as mosquitoes or ticks) and microorganisms that generate diseases such as malaria, Rocky Mountain spotted fever, and Lyme disease. People who handle wild animals or ingest animal products are at increased risk. This section addresses some of the more common and worrisome infectious diseases associated with outdoor activities. Immunizations are discussed on page 449.

Recommendations for drugs to treat these diseases are based on current literature. These recommendations may change—and some undoubtedly will, because new and better treatments are being discovered, organisms can acquire resistance to certain chemical agents, and toxic side effects to certain drugs will be revealed. It is important for physicians and laypeople who will assume responsibility for treating others to remain informed about current therapies.

MALARIA

Malaria is caused by infection with one of four microscopic protozoan parasites: *Plasmodium falciparum*, *P. vivax*, *P. malariae*, or *P. ovale*. These are transmitted in the wild by the bite of an infected *Anopheles* mosquito. Of the nearly 430 species of *Anopheles* mosquitoes, only 30 to 40 transmit malaria. Most cases of malaria acquired by U.S. citizens are contracted in sub-Saharan Africa; most of

the remainder are linked to travel in Southeast Asia, Central and South America, the Indian subcontinent, the Middle East, and Oceania (Papua New Guinea, Vanuatu, and the Solomon Islands).

Mosquitoes bite humans to obtain a blood meal in order to produce eggs. When a female mosquito bites a human infected with malaria, it ingests an immature form of the parasite. In approximately 2 weeks, the parasite matures within the mosquito. When the infected mosquito bites a noninfected human, it releases malaria sporozoites (an immature form of the parasite), which mature in the human liver to become merozoites, and which then invade red blood cells. From these locations, the organisms can penetrate the vital organs, such as the brain, lungs, liver, and kidneys. Within a few days, the infected red blood cells burst and the parasites infect more red blood cells. The incubation period between acquisition of the parasites and the onset of symptoms is 8 to 40 days, depending on the species. Up to a third of victims may not show the disease until after 60 days from the time of the initial mosquito bite. Typical symptoms include a flu-like illness, with any or all of the following: headache, chills, sweats, fatigue, backache, pale skin, loss of appetite, muscle aches, nausea, diarrhea, and vomiting. These are soon followed by episodes of headache, intense chills (rigors), high fever, and sweating. Jaundice and anemia may occur. The episodes last 1 to 8 hours and are separated by 2 to 3 days, depending on the species.

Those infected with falciparum malaria may be significantly more ill, with episodes of fever and chills at closer intervals and lasting for more than 30 hours. In addition, there may be severe alteration in mental status, seizures, difficulty breathing, blood in the urine, severe anemia, and shock. Severe malaria can be fatal or lead to anemia, heart and kidney failure, and/or coma; untreated infections can cause recurrent illness for years.

Identification of the specific plasmodium is accomplished by observing the parasites under the microscope in blood smears. People infected with *P. falciparum* are treated with quinine sulfate in combination with pyrimethamine-sulfadoxine (Fansidar) or tetracycline. The most important new class of antimalarial drugs is the artemisinins, which are natural products that were first developed in China in the 1960s. Artemether, artesunate, artemotil, and dihydroartemisinin (all artemisinin, or *qinghaosu*, derivatives) have been shown to be effective in the treatment of severe *P. falciparum* malaria. One key advantage of these agents is that they are active against all of the red blood cell stages of the parasite. Also, so far there is limited if any resistance to these agents. Because all artemisinins are very effective in killing the parasites, they are cleared rapidly from the bloodstream; so, are combined with longer-acting drugs, such as mefloquine, lumefantrine, amodiaquine, or piperaquine in countries other than the United States. At the time of this writing, in the United States, intravenous artemisinin is still considered an investigational drug, so it must be obtained from the Centers for Disease Control and Prevention (CDC). It is used for 3 days, and then followed with a longer-acting oral drug such as doxycycline, clindamycin, atovaquone-proguanil, or mefloquine. A person infected with *P. vivax*, *P. malariae*, or *P. ovale* is treated with chloroquine and primaquine phosphate.

Unfortunately, there is not yet a useful vaccine against malaria. Avoidance of mosquito bites is key to prevention. Because the *Anopheles* mosquito tends to feed during the evening and nighttime, it is particularly important to sleep under nets or screens; spray living quarters (with, for instance, a pyrethrin-containing product) and clothing (with, for example, permethrin 0.5%, Duranon, or Repel Permanone; or concentrated Perma-Kill 4 Week Tick Killer, diluted and applied to clothing); and wear adequate clothing and insect repellent (N,N-diethyl-3-methylbenzamide, called DEET) at these times (see page 390).

If you travel to a region where *P. falciparum* is resistant to chloroquine and pyrimethamine-sulfadoxine, prophylaxis (prevention) can be accomplished with mefloquine. The adult dose is 250 mg (salt) weekly. The pediatric dose varies according to the weight of the child: weight 15 to 19 kg, 63 mg; weight 20 to 30 kg, 125 mg; weight 31 to 45 kg, 188 mg; and over 45 kg, 250 mg. (For estimating purposes, 1 kg equals 2.2 lb.) Mefloquine should be started 1 to 2 weeks before travel, and then administered once a week during travel in malarious areas and for 4 weeks after you leave such areas. Mefloquine should not be taken during pregnancy. This drug should not be used by persons with psychiatric disease or history of depression or seizures. Side effects include nausea and vomiting, dizziness, mood changes, difficulty sleeping and nightmares, headache, and diarrhea.

An alternative drug for travelers who cannot take mefloquine is doxycycline (the adult dose is 100 mg a day beginning 1 to 2 days before travel and continuing for 5 to 6 weeks after; the pediatric dose for those aged more than 8 years is 2 mg/kg of body weight a day, up to the adult dose). Doxycycline is not advised for pregnant women or children under age 8 years, and may cause increased skin sensitivity to sunlight.

A final drug prophylaxis regimen against malaria is chloroquine phosphate (the adult dose is 300 mg of the base once a week; the pediatric dose, 5 mg/kg of the base, up to the adult dose, once a week), which should be taken 1 to 2 weeks before you enter a malarious region and continued until 1 month after your journey. Chloroquine is recommended for travelers, particularly pregnant women and children who weigh less than 33 lb (15 kg), who cannot take mefloquine or doxycycline. If you use chloroquine for prophylaxis, you should also carry three tablets of Fansidar to be taken in the event of a flu-like illness or other unexplained fever, assuming the absence of an allergy to sulfonamide antibiotics. Chloroquine should not be used by persons with retinal problems and has side effects of headache and itching.

Proguanil (Paludrine) is a drug that may be used for antimalarial prophylaxis in areas where *P. falciparum* is resistant to chloroquine. The drug is available without prescription in parts of Europe, Scandinavia, and Africa, but is as yet unavailable in the United States. It is administered in an adult dose of 200 mg daily (pediatric dose: under 2 years, 50 mg; age 2 to 6 years, 100 mg; age 7 to 10 years, 150 mg; over 10 years, 200 mg), along with weekly chloroquine (the latter to protect against other forms of malaria). It can be used by those who will

spend more than 3 weeks in rural areas of East Africa (particularly Kenya and Tanzania), but does not appear to be useful in Papua New Guinea, West Africa, or Thailand.

Atovaquone in combination with proguanil hydrochloride is available as the drug Malarone. The drug is taken at the same time each day with food or a milky drink. Treatment should be started 2 days before entering a malaria-endemic area and continued for 7 days after return. The adult dose is one tablet (250 mg atovaquone/100 mg proguanil) per day. Each pediatric tablet of Malarone contains atovaquone 62.5 mg/proguanil 25 mg. The pediatric dose is based on weight: 11 to 20 kg, one pediatric tablet per day; 21 to 30 kg, 2 tablets; 31 to 40 kg, 3 tablets; greater than 40 kg, one adult tablet. It should be noted that if Malarone is taken with tetracycline, metoclopramide, rifampin, or rifabutin, it may be less bioavailable and thus potentially less effective. It should not be used by persons with significant kidney disease.

Pyrimethamine plus dapson (drug combination: Maloprim) is prescribed in many malaria-endemic regions outside the United States. This drug cannot be used by pregnant women; it can also cause bone marrow suppression.

If you are stricken with malaria in an area where the malaria organism(s) is believed to be sensitive to chloroquine, but you have not been taking prophylaxis, begin treatment with chloroquine (adult dose, 600 mg of the base immediately, followed with 300 mg at 6 hours and once a day on days 2 and 3; pediatric dose, 10 mg/kg of body weight [up to 600 mg] of the base immediately, followed by 5 mg/kg at 6 hours and once a day on days 2 and 3). In a region where *P. falciparum* is resistant to chloroquine, administer quinine sulfate (adult dose, 650 mg every 8 hours for 3 days; pediatric dose, 8 mg/kg [up to 650 mg] every 8 hours for 3 days) *plus* tetracycline (adult dose, 250 mg four times a day for 7 days; pediatric dose, 5 mg/kg [up to 250 mg] four times a day for 7 days) or Fansidar (adult dose, 3 tablets; pediatric dose: weight 5 to 10 kg, ½ tablet; weight 11 to 20 kg, 1 tablet; weight 21 to 30 kg, 1½ tablets; weight 31 to 45 kg, 2 tablets; weight over 45 kg, 3 tablets). (For purposes of estimation, 1 kg equals 2.2 lb.) Malarone is sometimes used to treat acute malaria caused by *P. falciparum*. In this case the dosage for treatment is based on body weight: 5 to 8 kg, 2 pediatric tablets each day for 3 consecutive days; 9 to 10 kg, 3 pediatric tablets for 3 days; 11 to 20 kg, 1 adult tablet for 3 days; 21 to 30 kg, 2 adult tablets for 3 days; 31 to 40 kg, 3 adult tablets for 3 days; greater than 40 kg, 4 adult tablets for 3 days. Halofantrine (Halfan) is used to treat chloroquine-resistant *P. falciparum* infections in a dose of 500 mg every 6 hours for three doses, with repeat therapy in 7 days.

In any case of suspected malaria, seek the advice of a physician as soon as possible. Anticipate that a stricken individual, particularly a child, may develop extremely low blood glucose (sugar).

To determine the malaria risk within a specific country and to learn of the most recent recommendations for prophylaxis and drug therapy, you can seek information from one of many sources on the Internet, such as www.cdc.gov/malaria/.

YELLOW FEVER

Yellow fever is a viral disease transmitted in the jungle by mosquitoes of the genus *Haemagogus* and in urban areas by *Aedes aegypti* mosquitoes. “Jungle” yellow fever is seen in forest-savanna zones of tropical Africa, parts of Central America, forested areas of South America, and Trinidad. The “urban” variety is seen in South America and West Africa. The disease has not yet been noted in Asia.

The illness begins 3 to 6 days after the culprit mosquito bite(s). Symptoms include sudden onset of fever, headache, red eyes, muscle aching, nausea, and vomiting. These symptoms last for 3 to 4 days, after which there may be 12 to 24 hours of remission. Soon thereafter comes an “intoxication phase,” in which the seriously stricken victim develops fever, skin rashes, altered mental status, low blood pressure, and liver and kidney failure. In such cases, the victim becomes jaundiced (hence, “yellow” fever) and bleeds easily. The disease can be fatal. Treatment is supportive and based on symptoms. Because of the bleeding problems, do not use aspirin to control fever.

Since yellow fever is so difficult to treat, it is essential to use yellow fever vaccine and mosquito control measures (see page 390). A live-virus vaccine is available. A single injection induces immunity after 10 days that is adequate for 10 years (see page 453).

DENGUE FEVER

Dengue fever is a viral (flavivirus) disease transmitted by *Aedes albopictus* and female *A. aegypti* mosquitoes. It is estimated that 50 to 100 million people in more than 100 countries are infected each year with dengue viruses. There are four different types of dengue virus, and there is no cross-immunity, so a person may be stricken with dengue fever four times in his life. The most active feeding times for dengue vector mosquitoes is for a few hours after daybreak and in the afternoon for a few hours just after dark (dusk). As opposed to the night-feeding mosquitoes that transmit malaria, these species tend to be “urban,” may also feed during daylight hours (also indoors, in the shade, and during an overcast), and are known to bite below the waist. Dengue fever is seen chiefly in the Caribbean and South America, as well as other tropical and semitropical areas, such as Southeast Asia, Africa, and Mexico. In the United States, cases have been noted in Texas. The larvae flourish in artificial water containers (e.g., vases, tires), often in a domestic environment.

The incubation period following a mosquito bite is 2 to 8 days. The disease is self-limited (5 to 7 days) and characterized in older children and adults by a sudden onset of severe headache, sore throat, fatigue, cough, high fever (greater than 39°C or 102.2°F), chills, muscle aches, sore throat, reddened eyes, enlarged lymph nodes, nausea, bone and joint pain (“breakbone fever”), and a fine, red, itchy skin rash that typically appears simultaneously with the fever on the proximal arms, legs, and trunk (it spares the face, palms, and soles). It may then spread to the

face, and farther out on the arms and legs, becoming slightly darker and more solid. Although the fever usually remits spontaneously, an occasional victim will relapse. Some victims have a cycle of a few days of fever, then 1 to 3 days without fever, then fever again. It is not uncommon to suffer central nervous system manifestations, such as irritability, depression, seizures, or severe altered mental status. Children under 1 year of age appear to be particularly vulnerable to especially severe forms of dengue virus infection, associated with severe bleeding problems (dengue hemorrhagic fever: nosebleed, bleeding gums, severe abdominal pain, bloody vomit, darkened stool, restlessness, weakness, etc.) and circulatory problems that can lead to extremely low blood pressure (shock—see page 60). When this occurs, the victim may develop a diffuse, dark purple, blotchy rash caused by bleeding into the skin.

Treatment is supportive and based on symptoms. Fever should be treated with acetaminophen, and not with aspirin. There is no vaccine available against dengue fever. Insect repellents (particularly those containing DEET; see page 390) are critical for prevention.

CHIKUNGUNYA DISEASE

Chikungunya disease is similar to dengue fever. It is indigenous to tropical Africa and Asia. Caused by transmission of an alphavirus from a bite from the mosquito *Aedes aegypti* or *A. albopictus*, Chikungunya disease carries an incubation period of 2 to 12 (usually 3 to 7) days, followed by fever, headache, pain on looking at the light, pain behind the eyes, sore throat, nausea, vomiting, and weakness. On days 1 to 3, there may appear a red rash, followed by muscle aches and painful joints with arthritis. The arthritis may last for months to years. Therapy is symptomatic. As with dengue, proper use of insect repellents is critical.

WEST NILE VIRAL DISEASE

West Nile (named from the West Nile province of Uganda) viral disease (West Nile virus: WNV) is caused by a flavivirus (such as those that cause St. Louis encephalitis, Japanese encephalitis, and Murray Valley encephalitis) carried predominantly by mosquitoes (*Culex pipiens* in the eastern United States, *C. pipiens quinquefasciatus* in the southern United States, and *C. tarsalis* in the western United States, *Aedes*, *Anopheles*, and many other species) and at least 160 species of birds, although it has been found in small mammals and to an alarming degree in horses. The mosquitoes become infected by feeding on birds and many animals (e.g., bats, horses, chipmunks, dogs, rabbits, reindeer, squirrels, and even alligators). It appears to be transmitted to humans by mosquito bite and has been presumed to have arrived in the United States from the Middle East. In rapid fashion, it appears to have spread across the United States. The four top species of wild birds affected by WNV are American crows, Western

scrub-jays, yellow-billed magpies, and Steller's jays. Mosquitoes bite the birds and thus acquire the virus. West Nile viral disease is endemic in Africa, the Middle East, and West Asia. The virus has been spread to the recipient of an organ transplant from an infected donor, from a pregnant mother to a fetus, by blood transfusion, and possibly through breast milk. Otherwise, it does not appear to spread from human to human. While much of the clinical WNV activity is noted in summer and autumn, it is certainly possible to acquire the disease in winter from the bite of an infected mosquito.

The incubation period after a bite from an infected mosquito until the onset of illness is 3 to 14 days. The victim usually suffers a flu-like illness lasting for 3 to 6 days, characterized by fever, headache, neck stiffness and pain, swollen lymph glands, muscle aches and weakness, loss of appetite, fatigue, diarrhea, vomiting, red bumpy rash (commonly on the chest, abdomen, and back), and aversion to light (sometimes interpreted by victims as eye "pain"). Fatigue may be a residual symptom for up to a month. In 1 in every 100 to 300 cases, the victim suffers severe encephalitis (inflammation of the brain) with stiff neck and severe altered mental status (including coma or double vision), as well as paralysis. Convulsions are rare. Elders are more prone to suffer severe or fatal illness. Death is uncommon.

Most (80%) people infected with WNV never realize that they have had the disease, because they remain without symptoms. Twenty percent of infected people develop West Nile fever, and less than 1% of people infected develop severe medical illness, including meningitis and/or encephalitis (characterized by seizures, loss of vision, and disorientation) or paralysis. There are blood tests for WNV that measure antibodies to the virus, and show positive in most infected people within 8 days of the onset of symptoms. However, they may initially be "negative" and need to be repeated at a later date. There is no specific treatment, other than supportive therapy. Recovery is generally complete for survivors, although persistent neuropsychological problems (fatigue, memory problems, weakness, tremor, word-finding difficulties, headaches, and depression) may occur, even if the acute disease was mild.

Prevention is essential. First and foremost, that means preventing mosquito bites. Here are some recommendations:

1. Do not maintain standing water that serves as a breeding ground for mosquitoes, which lay eggs in the water. Drain or dump all standing water on a weekly basis. This includes water as shallow as 1 inch deep, as may be found in flower pots, planter bases, old tires, child pools, and so on.
2. Be sure that all doors and windows have tight-fitting screens. Repair any holes or rips, and if possible, treat screens and door jambs with mosquito control products.
3. Most bites occur at dawn and dusk, so limit outdoor activities during these times.
4. Use effective insect repellents, such as those containing DEET (N,N-diethyl-m-toluamide) or picaridin (KBR 3023). Use repellents

according to the manufacturer's labeled instructions, and reapply frequently, particularly if you swim or become sweaty.

5. Wear clothing designed to cover your arms and legs, including long sleeves and pants.

RELAPSING FEVER

The sporadic (in occurrence) form of relapsing fever is caused by various borrelial organisms transmitted by argasid (soft) ticks of multiple *Ornithodoros* species. For instance, tick-borne relapsing fever in the western United States and Canada is caused by *Borrelia hermsii*, transmitted by the *Ornithodoros hermsii* tick. The epidemic form of relapsing fever is transmitted by the human body louse. In the United States, relapsing fever is largely confined to the western portion of the country, where the ticks inhabit coniferous forests in the remains of dead trees and burrows occupied by mice, rats, and chipmunks.

The disease is more common in men, who may occupy the poorly maintained cabins and huts that rodents like to visit. The classic case involves a tick bite and a 7-day incubation period, followed by the abrupt onset of high fever, shaking chills, severe headache, muscle and joint aches, abdominal pain, nausea, and vomiting. This lasts for about 3 (but may be 1 to 17) days, until there is a crisis wherein the fever drops while the victim undergoes drenching sweats and intense thirst. For a subsequent period that averages 7 days, there is no fever and minimal symptoms, and then a relapse into illness. This cycle recurs an average of three times, with each episode of illness generally less severe. The sporadic (tick-borne) variation tends to be less severe; mortality rates of up to 40% have occurred in louse-borne epidemics.

A physician can make the diagnosis by examining a smear of the victim's blood under the lens of a microscope and observing the causative organisms. Treatment is tetracycline or erythromycin 500 mg by mouth four times a day for 10 days. When the victim ingests the antibiotics, he may suffer a high fever and low blood pressure (shock—see page 60) as a reaction to the death of the organisms within his bloodstream. Therefore, if you suspect relapsing fever, unless the victim is extremely ill, it is best to have him treated in a hospital, where this reaction can be anticipated and managed. If you are forced to treat in the field, be certain that the victim is well hydrated (see page 208), and administer a lower dose (250 mg) of antibiotic for the first four doses.

TYPHOID FEVER

Typhoid fever is caused by the bacteria *Salmonella typhi*, which are transmitted among humans through ingestion of contaminated food or water. Most cases are acquired abroad under conditions of poor hygiene.

After an incubation period of 10 to 14 days, victims suffer fever with or without diarrhea and abdominal pain. Most victims also complain of headache, fatigue, and loss of appetite. “Rose spots,” which are 2 to 4 mm red spots on the trunk that blanch (lose their color) when pressed, are seen in some cases. The liver may become inflamed.

Most cases resolve in 3 to 4 weeks. The seriously stricken individual may suffer a severely inflamed bowel, bleeding from the gastrointestinal tract, pneumonia, heart failure, severe fever, and death.

A physician who diagnoses typhoid fever will treat the victim with an intravenous antibiotic. The layperson can use trimethoprim-sulfamethoxazole; administer one double-strength tablet twice a day for 2 to 3 weeks. You can also use ampicillin 100 mg/kg (2.2 lb) of body weight in four divided doses for 2 to 3 weeks. It is important to keep the victim from becoming dehydrated (see page 208).

Injectable and oral vaccines (see page 456) to prevent typhoid fever are available to people traveling to areas of high risk.

LASSA FEVER

Lassa fever is a viral disease transmitted to humans principally through the body secretions of the *Mastomys natalensis* rat. It occurs primarily in sub-Saharan West Africa.

The infected victim suffers a gradual onset of headache, fever, and fatigue. There is often a severe sore throat, and there may be diarrhea and/or reddened eyes. Victims often complain of chest pain behind the breastbone, which may be caused by inflammation of the throat and esophagus. Roughly a quarter of victims develop bleeding complications. If the case is nonfatal, resolution begins in 8 to 10 days. In a fatal case, the victim progresses to develop altered mental status, shock, and severe breathing disorders.

The viral hemorrhagic (bleeding) fevers (Lassa, Marburg, Ebola, and Crimean-Congo) can all be spread among humans by transfer of secretions (blood and body fluids). Therefore, it is important to isolate suspected victims as best as possible from other humans during their care. Transfer to a medical facility for specific drug therapy may be critical to survival. Field care is supportive and similar to that for yellow fever (see page 150).

SCHISTOSOMIASIS

Schistosomiasis is a term that describes a variety of diseases caused by different species of parasitic flatworms. The intermediate hosts are freshwater snails, which release the immature infective stages into the water; thus, the infections are acquired by people who bathe or swim in contaminated water. The early

symptoms caused by all of the species of worms are similar. When the fork-tailed cercariae (early stages of the immature worm) penetrate the skin, they cause itching and a rash at the site of entry that may begin within a few hours to a week after exposure and lasts for 1 to 2 days. Four to 6 weeks later, the victim shows loss of appetite, fatigue, night sweating, hives, and late-afternoon fever lasting 5 to 10 days ("snail," "safari," "Katayama," or "Yangtze River" fever). After a few months, the different species cause specific organ damage.

Schistosoma haematobium is prevalent in Africa, the Middle East, the islands of Madagascar and Mauritius, and India. The worms take residence in the blood vessels of the bladder and genitalia, and induce bloody, painful, and frequent urination. The other four species of worms cause scarring in the intestines and liver. *S. mansoni* is prevalent in Africa, the Arabian peninsula, Madagascar, Brazil, Suriname, Venezuela, and some Caribbean islands. The worms take residence in the blood vessels surrounding the large bowel and induce bloody and mucus-laden diarrhea. In late stages of the disease, the liver can be severely damaged. *S. japonicum* is prevalent in China, the Philippines, Japan, and the island of Sulawesi. The worms take residence in the blood vessels supplying the small bowel and induce severe, bloody, and mucus-laden diarrhea. *S. intercalatum* infections occur in sub-Saharan Africa and *S. mekongi* infections along the Mekong River in Cambodia and Laos. "Katayama fever" consists of fever, headache, muscle aches, abdominal pain in the right upper quadrant (liver), and bloody diarrhea. This occurs 2 to 6 weeks after the onset of schistosomiasis.

The diagnosis is usually made by identification of schistosome eggs in feces or urine. Treatment for schistosomiasis includes the prescription antihelminthic (antiparasitic) drug praziquantel.

To prevent schistosomiasis, it is necessary to prevent the entry of cercariae into the body. In a region of high risk, it is unwise to bathe or swim in an untreated pond or stream. Shallow, stagnant water is more contaminated than that in swift-moving currents. Always wear hip boots or waders when passing through streams or swamps. If contact with water occurs, apply rubbing alcohol to your skin and briskly towel off. Boil or disinfect all bathing water, or store it for 3 days (the life span of the cercariae) before using it; also be certain that it is free of snails. Artemether is a drug that can be given alone or in combination with praziquantel to prevent schistosomiasis in high-risk situations. There is not yet an effective repellent or vaccine against schistosomiasis.

ROCKY MOUNTAIN SPOTTED FEVER

Rocky Mountain spotted fever is caused by *Rickettsia rickettsii*, a tick-borne parasite. The disease is most commonly noted in late spring and early summer, when people are more likely to be outside and become hosts for the dog tick (*Dermacentor variabilis*) or western wood tick (*D. andersoni*). Other ticks can also carry the parasite.

Most infections are reported in the southeastern states: North Carolina, South Carolina, Texas, Tennessee, Virginia, Maryland, and Georgia.

The incubation period is 2 to 14 (average 7) days after the tick bite, at which time a high fever begins abruptly. Two to 6 days after the onset of fever, the red-spotted rash typically begins on the hands (including the palms), wrists, feet (including the soles), and ankles, and then spreads toward the trunk. The face is less often involved. At first, the rash is composed of pink spots that blanch with pressure; they later become darker red or purplish. As the disease advances, the spots coalesce to form purple blotches. However, some victims never develop a rash (Rocky Mountain “spotless” fever).

Other symptoms that begin before the onset of the rash include headache (common), chills, joint and muscle aching, cough, puffy eyelids and face, swollen hands and feet, reddened eyes, abdominal pain, nausea, and vomiting. Severe cases can affect multiple organ systems and cause death.

If you suspect that someone is suffering from Rocky Mountain spotted fever, seek a physician’s help immediately. Doxycycline (adult dose, 100 mg twice a day) or tetracycline (adult dose, 500 mg four times a day; pediatric dose, 10 mg/kg four times a day) should be given for 6 days, or continued until the victim is without fever for 3 days. Although it is generally not recommended that you administer doxycycline or tetracycline to a pregnant woman or to a child less than 6 years of age, because of the risk of tooth discoloration or abnormal bone development (the latter in a fetus during pregnancy), in a case of suspected Rocky Mountain spotted fever when a physician is not available to administer an alternative antibiotic, doxycycline or tetracycline should be given.

COLORADO TICK FEVER

Colorado tick fever is caused by a virus transmitted to humans by the wood tick *Dermacentor andersoni*, and perhaps by other species. It is a seasonal illness that occurs from late March to early October, with peak incidence in May and June, usually in people who recreate outdoors.

The usual incubation period—from tick bite to symptoms—is 3 to 6 days. The victim complains of sudden onset of fever, severe headache, muscle aches, and fatigue. Other symptoms may include aversion to light, eye pain, loss of appetite, abdominal pain, and nausea and vomiting. Only 5% to 10% of victims develop a skin rash. The hallmark feature, which is only observed in half of victims, is a distinctive fever pattern. There is a fever for 2 to 3 days, a 1- to 2-day remission, and then an additional 2 to 3 days of fever. Permanent effects and serious complications are rare, but do occur, more commonly in children under age 10 years.

A victim of Colorado tick fever may require 3 weeks or longer to recover fully; the most common persistent symptoms are fatigue and weakness. However, infection appears to confer lifelong immunity to subsequent exposures to the virus.

LYME DISEASE

Lyme disease, caused by infection with the spirochete *Borrelia burgdorferi*, is the most common tick-borne illness in the United States. Occurrence is most frequent in summer and early autumn, during peak outdoor activities. The two hard ticks implicated in transmission of the spirochete from mammal to mammal (for example, from white-footed mouse *Peromyscus leucopus* to the white-tailed deer *Odocoileus virginianus* in the South; from the dusky-footed wood rat *Neotoma fuscipes* and the California kangaroo rat *Dipodomys californicus* to larger mammals in northern California) are *Ixodes scapularis* (deer tick) in the Northeast, South, and Midwest, and *I. pacificus* (western black-legged tick) in the West.

The adult ticks of these species are extremely small—about the size of a sesame seed. Worse yet, the disease can be transmitted by the nymphal forms, which may appear only as minuscule black spots on the skin. Other potential carriers of *Borrelia burgdorferi* in the United States include the dog tick, wood tick, rabbit tick, and Lone Star tick (*Amblyomma americanum*); however, these ticks may not transmit the disease. Lyme disease has been reported in Canada, the Soviet Union, Australia, Europe (linked to the sheep tick *I. ricinus*), Scandinavia, Japan, and China. In Asia, the culprit tick is *I. persulcatus*.

The distinctive skin lesion of Lyme disease, erythema (chronicum) migrans, appears 3 to 32 days (usually, about a week) after the tick bite. It is attributed to *B. burgdorferi* that are spreading locally in the skin, and is usually found on the trunk, upper arm (or armpit), or thigh as a small red spot that expands into a large (average 7 in or 18 cm, but up to 30 in or 76 cm, in diameter) and irregular circle or oval with a red, raised, or flat outer border surrounding paler (“fading,” but slightly red) skin in the center. The rash may itch or burn, and is warm to the touch. The initial central spot may turn into a blister or small ulcer, or it may turn blue in color. In some cases, multiple similar red areas appear simultaneously, occasionally within the larger primary lesion, but never on the palms or soles. These areas clear spontaneously over 1 to 14 (average 4) weeks. Variations of the rash include diffuse hives or a more measles-like eruption. An untreated victim may develop recurrent rashes 1 to 14 months after the initial rash disappears.

Within days to weeks of infecting a human, the *B. burgdorferi* organisms spread from the skin through the bloodstream and lymphatic system to affect other organs. Therefore, appearing just before, or coincident with, the skin rash(es) are flu-like symptoms that include muscle aching (particularly of the calves, thighs, and back), stiff neck, fatigue, low-grade fever, chills, painful joints, loss of appetite, nausea, cough, sore throat, swollen lymph glands, enlarged spleen, headache, abdominal pain (particularly in the right upper quadrant), irritated eyes (conjunctivitis), swelling around the eyes, and aversion to light. Most of the symptoms disappear in 2 to 3 weeks (along with the rash), but fatigue and muscle aching may last for months.

More serious symptoms include severe headaches and a stiff neck suggestive of meningitis (see page 174), confusion, profound sleepiness or insomnia,

memory disturbances, emotional changes, and poor balance. Pain in the joints and symptoms of hepatitis may also occur.

Pets can also contract this disease, suffering lameness, swollen joints, lethargy, and loss of appetite.

If Lyme disease is not treated with an antibiotic, the disease can progress to facial paralysis and severe heart and nervous system disorders weeks to months after the initial rash disappears. Months or years later, up to 60% of untreated victims will suffer arthritis.

Antibiotic therapy for Lyme disease at the time of the initial rash or symptoms should be given for 2 to 3 weeks. Treatment may be extended to 4 weeks if symptoms persist or recur. For an adult, use doxycycline 100 mg twice a day. An alternative is amoxicillin 500 mg orally three times a day. If the victim is allergic to tetracycline and amoxicillin, he may take cefuroxime axetil 500 mg orally twice a day or erythromycin 250 mg orally four times a day. A child should be treated with amoxicillin 17 mg/kg (2.2 lb) of body weight (up to 250 mg) three times a day. If the child is allergic to penicillin, administer cefuroxime axetil 125 mg or 15 mg/kg (2.2 lb) of body weight or erythromycin 250 mg or 10 mg/kg (2.2 lb) of body weight 3 times a day. Nearly 15% of persons treated with antibiotics for Lyme disease in this fashion may develop fever, flushed skin, and low blood pressure within 24 hours of treatment. This may require physician intervention for intravenous fluids.

A physician may elect to treat certain Lyme disease victims with a daily injection of ceftriaxone for 2 weeks. There are occasional treatment failures; these people may require hospitalization for another intravenous antibiotic.

Prevention is key. Avoid tick bites by wearing proper clothing (light colored for spotting ticks, tightly woven collared shirts, closed boots, long sleeves and pant legs, hats) impregnated with 0.5% permethrin (Permanone) insecticide or N,N-diethyl-3-methylbenzamide (DEET) repellent in the critical locations (see page 390). When traveling in tick country, keep shirts and pant cuffs tucked in. All hair-covered areas and warm, moist locations on the skin should be inspected carefully. Any tick found on the skin should be removed promptly and properly (see page 386). Following a tick bite, watch for the characteristic rash and symptoms. Some authorities believe that a tick must be attached to a human for at least 36 to 48 hours to transmit Lyme disease, but this has not yet been proven. Most authorities agree that the risk of transmission increases with the duration of tick attachment.

It has not yet been proven that administration of an antibiotic to every person bitten by an *Ixodes* tick is a cost-effective method to prevent this disease. However, in an area where carrier ticks and the disease are frequent, it is not unreasonable to administer an appropriate antibiotic within 72 hours following removal of an embedded or blood-engorged tick. Suggested drug regimens include amoxicillin 500 mg three times a day or doxycycline 100 mg twice a day for 10 days. In the absence of an allergic reaction to the antibiotic, this therapy is generally safe.

EHRlichiosis AND ANAPLASMOSIS

Human ehrlichiosis (there is also a canine form) is present in two forms, one caused by a rickettsial organism known as *Ehrlichia chaffeensis*, which is spread by *Amblyomma americanum* tick bites, and the other caused by the rickettsial organisms *E. phagocytophila* and *E. equi*, spread by *Ixodes* tick bites. Infection is usually acquired by a person who inhabits a rural environment. The average incubation period after a bite is approximately 7 to 10 days. The victims, who are more commonly middle-aged adults than children and young adults, complain of a flu-like syndrome with high fever, chills, fatigue, headache, muscle aches, vomiting, and a variety of skin rashes, which can be punctate, bumpy, like tiny bruises, or broad and reddened. A victim often has decreased counts of various types of blood cells, as well as liver dysfunction. The treatment is tetracycline 500 mg four times a day, or doxycycline 100 mg twice a day, for 10 days. The few children who have been diagnosed with ehrlichiosis have been treated with doxycycline 3 mg/kg of body weight in two divided doses per day. Untreated or treated after a delay in diagnosis, up to 15% of victims can develop severe infections, kidney failure, bleeding disorders, seizures, and/or coma.

Human anaplasmosis, which was formerly called human granulocytic ehrlichiosis, is caused by infection of white blood cells by a bacterium named *Anaplasma phagocytophilum*. Like ehrlichiosis, anaplasmosis is disseminated by bites of *Ixodes* ticks, the blacklegged tick (*I. scapularis*) in the Northeast and upper Midwest, and the western blacklegged tick (*I. pacificus*) on the West Coast. Infected persons have the onset of illness 5 to 21 days after a bite with symptoms of fever, headache, fatigue, and muscle aches, which may progress to more serious illness affecting the kidneys, central nervous system, lungs, and blood system. The treatment is the same as for ehrlichiosis.

BABESIOSIS

Babesiosis is caused by protozoan parasites that invade human red blood cells. They are transmitted from mammals and rodents to humans by the bite of certain hard ticks. For instance, *Babesia microti* in New England is transmitted by the northern deer tick *Ixodes scapularis*, which can also transmit the spirochete agent of Lyme disease.

An infection manifests itself in a human with symptoms of fatigue, loss of appetite, and weakness, followed within a few days to a week by fever, sweats, and muscle aches. Less common symptoms include headache, nausea, vomiting, and chills. There is rarely a rash. The victim may suffer anemia and an enlarged spleen. A person who no longer has a spleen may suffer a more serious or prolonged illness.

A physician can make the diagnosis by observing the parasites in a smear of human blood under the lens of a microscope. Most victims recover without treatment. In severe cases, a physician may administer drugs, such as quinine and clindamycin.

TRICHINELLOSIS (TRICHINOSIS)

Trichinellosis (trichinosis) is a disease that occurs in humans who consume the larvae of *Trichinella* species (such as *spiralis* and *nativa*) that have encysted in animal muscle tissue (meat). Most of us are familiar with the risk associated with eating undercooked pork, but be aware that cases have resulted from consumption of horse meat, wild boar, bear, walrus, and cougar, the latter in jerky form (which was brined and smoked, but never heated during preparation). Squirrels, woodchucks, capybaras, mice, and rats are infected in nature.

Victims of trichinellosis first develop gastrointestinal distress (nausea, vomiting, diarrhea, and abdominal pain) during the week following ingestion of infested meat. This may continue for 4 to 6 weeks. During the second week, when the larvae are invading human muscle tissue, high fever, muscle aches, swelling (edema, puffiness) of the soft tissues around the eyes, weakness, skin rash, and joint aches develop. There may be tiny red hemorrhages under the fingernails or visible within the skin. In addition, analysis of human blood shows an unusually high count of eosinophils, which are a cell type associated with allergies and certain parasite infestations.

The migrating larvae can cause damage to the lungs (cough, bloody sputum, shortness of breath, pain with breathing), heart, and brain.

The larvae encyst in the muscle tissues, beginning the second or third week of infection, which causes muscle aches and stiffness. Then the larvae die; they become calcified 6 to 18 months after the infection first occurred.

The definitive diagnosis is made in humans by a blood test or muscle biopsy (examining a small piece of muscle harvested from the patient for *Trichinella* cysts and muscle inflammation with a concentration of eosinophils). Treatment for a person with trichinellosis is not yet totally satisfactory; it involves administration of the drug thiabendazole or mebendazole.

Although most species of *Trichinella* are killed by freezing, there are freeze-resistant strains, so all meat that is at a high risk for carrying the parasite should be cooked thoroughly to a temperature of at least 150°F to 170°F (65.6°C to 77°C), which generally occurs when the meat turns from pink or red to gray. Certain brining solutions may kill *Trichinella*; however, the curing temperature must be sufficiently high.

LEPTOSPIROSIS

Leptospirosis is caused by the spirochetes of *Leptospira* species. The organisms are shed in the urine of wild and domestic animals, including cows, dogs, and pigs. Humans acquire the disease by contacting contaminated soil or water, which includes freshwater ponds and streams. The spirochetes can enter through nicked or abraded skin, through the mucous membranes of the eye and mouth, or by being ingested.

After an incubation period of 5 to 14 days, many victims display fever, chills, fatigue, muscle aches, headache, swollen lymph glands, and red eyes without a

discharge. Nausea, vomiting, abdominal pain, and cough are common symptoms as well. This presentation lasts for about a week, and then is followed by a few days of improvement, after which a second stage of the disease begins. This is characterized by more muscle aches, nausea and vomiting, and a diffuse skin rash (red or purplish patches of skin). A sore throat, enlarged spleen, abnormal heart rhythms, low platelet count, and enlarged liver with jaundice may develop. In very severe cases, the victim may suffer from kidney and liver dysfunction, and even bleeding from the lungs.

The treatment is doxycycline 100 mg by mouth twice a day, or tetracycline 500 mg four times a day, for 7 days. Other antibiotics that can be used are amoxicillin, cefuroxime axetil, penicillin, and erythromycin.

To avoid infection, it is best not to swim in freshwater ponds and streams likely to be heavily contaminated by urine from livestock or wildlife.

TULAREMIA

Tularemia is caused by the bacterium *Francisella tularensis*, which can be transmitted to humans by tick bites, or by handling, skinning, or eating improperly cooked infected rabbit meat. Rarely, it can be transmitted from a cat, bear, deer, beaver, or muskrat. Even more rarely, it can be inhaled (associated with gardening and lawn care) and cause pneumonia.

There are multiple clinical presentations of the disease, with combinations of the following signs and symptoms: painful and tender ulcers on the hand (from handling an infected animal) with associated swollen lymph glands behind the elbow and in the armpit; swollen lymph glands in the groin, associated with insect bites of the legs; sore throat; conjunctivitis in one eye with a swollen lymph gland in front of the ear on the same side; fever; chills; weakness; pneumonia; and weight loss.

A physician will use blood tests to confirm the diagnosis. Treatment is best rendered with intramuscular injections of streptomycin. If the victim cannot be brought to medical attention promptly, therapy may be initiated with tetracycline 500 mg four times a day, or ciprofloxacin 750 mg twice a day.

MENINGOCOCCAL DISEASE (INCLUDING MENINGITIS)

One of the most feared infectious diseases is meningitis caused by the bacterium *Neisseria meningitidis* (*meningococcus*). The infection can appear in outbreaks, most commonly abroad, particularly in sub-Saharan Africa and China. The infection is spread in the respiratory secretions of humans.

The disease appears in many forms, the most common of which are meningitis, pneumonia, and disseminated bacterial infection. The typical presentation of meningitis is fever, headache, and a stiff neck (see page 174). If the cause is meningococcus, the victim may develop a skin rash, which consists of red dots or bumps,

or a flat, more patchy dark red discoloration. If the dark red dots begin to enlarge and coalesce into large purplish bruise-like discolorations, this is a bad sign. In the worst cases, the victim develops shock, respiratory failure, diffuse bleeding, and death. Approximately 1 in 10 victims of meningococcal meningitis dies.

This is a true emergency. The victim needs large doses of intravenous antibiotics, such as ceftriaxone. If these are not available, administer a high oral dose of penicillin, cephalexin, cefixime, cefpodoxime, or amoxicillin–clavulanate acid for 10 days. If the victim is allergic to penicillin, use trimethoprim-sulfamethoxazole or ciprofloxacin. Ciprofloxacin may also be administered to all close (“household”) contact adults in a single dose of 500 mg. Azithromycin in a single dose of 500 mg by mouth may also be effective for prophylaxis against the disease in contacts. Rifampin may also be used for this purpose in adults (600 mg a day by mouth for 2 days) and children (younger than 1 month: 5 mg/kg by mouth every 12 hours for 2 days; older than 1 month: 10 mg/kg by mouth every 12 hours for 2 days). A physician may elect to prescribe an injection of ceftriaxone for this purpose.

An effective meningococcal vaccine is available (see page 453)

RABIES

Rabies is discussed on page 410.

Minor Medical Problems

Although the afflictions discussed in this section are rarely life threatening, they account for the majority of health care problems encountered in a recreational or wilderness setting. For the sake of simplicity, this section is organized by body organ system. Specific disorders can be rapidly located by using the index.

Whenever a person becomes ill, it is wise to consider how the disorder can become worse. For instance, bronchitis can progress to pneumonia in situations of stress and suboptimal environmental conditions. Therefore, if someone develops severe bronchitis, he should not continue to travel farther from civilization until it is clear that medical management is going to halt progression of the illness.

I have not included all of the problems that originate from substance abuse or indiscriminate sexual encounters. However, it is critical to observe that drinking alcohol or using mind-altering drugs impairs judgment and is a major contributor to injuries. It is inexcusable to dull your senses when such activity places you and others at risk.

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GENERAL SYMPTOMS

UNCONSCIOUS (OR SEMICONSCIOUS) VICTIM

As discussed in detail in the section “Major Medical Problems” (see page 21), a proper approach to the unconscious (comatose) victim may make the difference between life and death. You must evaluate the semiconscious (stuporous, dazed, confused, or combative) individual with the same degree of concern. To discover the cause of an altered mental status, you must be a bit of a detective, while also performing the tasks that prevent the victim from hurting himself. Always assume that an unconscious person may be seriously injured.

1. Open and maintain the airway (see page 22). Check for adequacy of the pulse (see page 33).
2. Protect the cervical spine (see page 37). *Every injured person has a broken neck until proven otherwise.*
3. Carefully examine the victim for evidence of an obvious injury and treat accordingly.
4. Consider low blood sugar, and treat the victim with glucose if he is alert enough to cooperate (see page 142). If not, and glucagon for injection is available, consider its use (see page 143).

Don't:

1. Don't shake a victim vigorously to awaken him without first protecting the neck. *Never* shake a victim to awaken him if you suspect that hypothermia (see page 305) is present. If you think that the victim is merely intoxicated, you may snap an ammonia inhalant or hold “smelling salts” under his nose, and allow him a few whiffs to stimulate awakening. If there is any chance of a neck injury, do not perform this maneuver without maintaining the head and neck in a stable position.
2. Don't attempt to carry an unconscious victim or manage a belligerent person if this might exhaust you. Send someone for help and stay with the victim until help arrives.
3. Unless there is no other way to get lifesaving help, never leave an unconscious or dazed person unattended.

FAINTING

Fainting is defined as sudden brief loss of consciousness not associated with a head injury. There are innumerable causes of fainting, but most episodes are associated with decreased blood flow (oxygen and/or glucose) to the brain. This may be caused by low blood sugar (hypoglycemia—see page 142), slow heart

rate (vagal reaction, in which the vagus nerve, which slows the heart rate, is overstimulated: fright, anxiety, stomach irritation, bowel dilation, drugs, fatigue, prolonged standing in one position), rhythm disturbances of the heart, dehydration, heat exhaustion, anemia, or bleeding.

If you witness a fainting episode, or are with someone who is becoming light-headed (sweating, weak, ashen colored, dizzy), quickly help the person lie down and elevate his legs 8 to 12 in (20 to 30 cm). This position increases venous blood flow back to the heart, which in turn pumps more blood to the brain. If the victim begins to vomit, turn him on his side. If he has fallen, examine him for injuries. A cool, moistened cloth wiped on his forehead, on his face, and behind his neck may make the victim feel better. Do not splash or pour water on his face or routinely use smelling salts or ammonia inhalants. Do not slap the victim's face.

After a victim suffers a fainting episode, he should be examined for any sign of serious illness or injury. If you don't suspect anything serious, have him lie still for a few minutes, and then sit for a few minutes. If the victim is alert and capable of purposeful swallowing, offer him cool sweetened liquids to drink—preferably one that contains electrolytes (see page 208)—to correct dehydration. When the victim feels normal, he may slowly regain an upright posture. If the victim is elderly, and particularly if his pulse is irregular or he has chest discomfort, seek immediate medical assistance. Anticipate a heart attack (see page 50).

FATIGUE

Fatigue (lethargy, tiredness, exhaustion, generalized weakness, decreasing exercise tolerance) can be a sign of any disorder or dysfunction that diminishes a person's energy level. Accompanied by fever, it can be indicative of an infection; accompanied by certain associated symptoms, it may indicate a hypoactive thyroid. In the outdoors, anyone who began the trip in good condition but is now fatigued should be examined carefully for signs and symptoms of hypothermia (see page 305), hyperthermia (see page 322), high-altitude illness (see page 335), infection, mental depression (see page 301), anemia (pale membranes inside the eyelid, pale fingernail beds, sallow skin complexion), dehydration (see page 207), or starvation. A diabetic who becomes fatigued may suffer from high or low blood sugar (see page 142). If fatigue is accompanied by shortness of breath, do not travel any farther from civilization until you determine a treatable cause, or the victim clearly improves. Sudden onset of fatigue can be indicative of a heart attack (see page 50).

If a person is suffering physical exhaustion, allow him at least 12 hours of rest, encourage adequate food intake, and take particular care to correct dehydration.

In a situation of extreme exercise within a particular muscle group—the legs during forced or military-style marching, or long-distance or marathon running; the arms during repetitive, relentless exertion such as weight lifting—muscle tissue can be broken down. This is more common under conditions of

environmental heat (see page 322). Substances (particularly myoglobin, a pigment that carries oxygen) are released into the bloodstream, which in large concentrations can cause the kidneys to fail. The victim has very darkened (brown) urine (myoglobinuria), sore muscles, and extreme fatigue. In this situation, remove the victim from environmental heat, place him at as near complete rest as possible, and encourage him to drink as much liquid as he can to correct dehydration and flush the pigment from his system (see page 208).

FEVER AND CHILLS

Fever is an elevation in body temperature caused by infection. The causative organism (most commonly a bacterium or virus) releases substances into the bloodstream; these quickly reach the part of the brain that acts as the body's thermostat. Thus, body temperature is "reset" at a higher level. This probably helps fight infection, but the temperature may need to be lowered if the elevation is extreme or prolonged.

Normal body temperature is 98.6°F (37°C) measured orally, and 99.6°F (37.5°C) measured rectally. To convert degrees Fahrenheit (F) into degrees Centigrade (C, or Celsius), subtract 32, then multiply by 5, then divide by 9. To convert degrees C into degrees F, multiply by 9, then divide by 5, then add 32. A temperature conversion chart is found on page 509.

Temperature should be measured with a thermometer. Electric (digital) thermometers are easiest to use and require the least time to record a temperature. If you use a mercury or alcohol thermometer, first shake it to pool the mercury or alcohol below the 94°F (35°C) marking. If you suspect the victim to be hypothermic, a special thermometer is necessary (see page 305). To take a temperature by mouth, place the thermometer under the tongue, close the mouth, and take a reading after 3 to 4 minutes. To take a temperature rectally (the more reliable method, and necessary in a case of suspected hypothermia), the thermometer is *gently* placed—ideally lubricated with oil or petroleum jelly—1 in (2.5 cm) into the rectum. It is held for at least 2 minutes and then read. Never leave a child or confused adult unattended with a thermometer in the mouth or rectum. *Do not rely on skin temperature to vary consistently with changes in core body temperature.*

Armpit (axillary) temperatures are far less reliable, because they may underestimate the temperature elevation. However, a high temperature recorded from the armpit may be interpreted to mean that there is some elevation in body temperature. An armpit temperature may be the only one you get in an uncooperative child less than 2 years of age. Since such a temperature tends to read on the low side, add 1.4°F (0.8°C) to obtain the equivalent rectal temperature.

Generally, an infection will not elevate the core (rectal) body temperature higher than 105°F (40.5°C). Anyone with a temperature measured above that level should be examined for heat illness (see page 322), stroke (see page 144), or drug overdose. Vigorous prolonged muscular activity (seizure or marathon running) can raise the core temperature above 107°F (41.7°C).

A child is considered to have a fever if his rectal temperature is greater than 100.4°F (38°C), oral temperature is greater than 100°F (37.8°C), or armpit temperature is greater than 99°F (37.2°C). You should be concerned about a fever greater than 100.4°F (38°C) in an infant less than 3 months of age or greater than 104°F (40°C) in any small child, because this can indicate a severe infection. If a child greater than 2 years of age has a fever greater than or equal to 106°F (41.1°C), and if there is no clear diagnosis of a viral infection, he should be treated with a broad-spectrum antibiotic (e.g., amoxicillin-clavulanate), on the rationale that there is a significant likelihood of a bacterial infection. Prolonged fever in a child should be investigated by a physician. Signs of a serious infection in an infant include lethargy (“floppy baby”), pain (persistent crying), labored breathing, purple skin rash, excessive drooling, a bulging “soft spot” (fontanel) on the top of the head, or a stiff neck.

If a person has a temperature higher than 100.5°F (38°C) that is thought to be due to an infection, he will be made more comfortable (fever lowered) by the administration of aspirin, ibuprofen (Motrin or Advil), or acetaminophen (Tylenol). To avoid Reye syndrome (postviral encephalopathy and liver failure), *do not use aspirin to control a fever in a child under age 17*. The traditional teaching is that infants and small children with fevers (usually due to ear infections or viral illnesses) should be treated as soon as any elevation of temperature is noted to prevent febrile seizures, although this may not actually be the case. An infant (younger than 6 months) with a fever should be seen as soon as possible by a physician. Sponging a child with cold water doesn't help much to reduce fever and can even be counterproductive if the child struggles or begins to shiver, both of which generate heat. If the fever is greater than 104°F (40°C), however, sponging can be attempted using lukewarm water. Never sponge a child with alcohol, because it can be absorbed through the skin and act as a poison.

If the victim suffers from environmental heat-induced illness (see page 322), he will not benefit from and should not be given aspirin or acetaminophen. Ibuprofen is not as dangerous but is also *not* helpful.

Whether to use an antibiotic for a “fever of unknown origin” (a fever that cannot be definitively linked to a specific site of infection) is a judgment call. If a person has an altered immune system (acquired immunodeficiency syndrome [AIDS], cancer, diabetes, chronic corticosteroid administration) and a high or persistent fever not associated with symptoms suggestive of a particular infection, it is probably wise to administer a “broad-spectrum” antibiotic, such as ciprofloxacin or azithromycin. If there are symptoms that lead you to a specific site of infection (such as cough—pneumonia; burning on urination and flank pain—kidney infection), the appropriate antibiotic should be started. Finally, any feverish small child can become rapidly debilitated; he will rarely suffer from the initiation of a common antibiotic, such as amoxicillin or trimethoprim-sulfamethoxazole.

Chills are caused by the release of bacteria or viruses (or their toxins) into the bloodstream. The victim will suddenly feel very cold and begin to shiver, with teeth chattering, goose bumps (piloerection), and weakness. The “chill” may actually occur during a temperature spike within a fever.

FEVER IN A RETURNED TRAVELER

It is not uncommon to acquire an infectious disease during outdoor travel, particularly to foreign (to the United States) countries. These illnesses are often accompanied by fever. As a general rule, infectious diseases follow periods of incubation. The incubation periods of travel-related infectious diseases, some of which may have fever as a component, are as follows:

- *Less than 10 days:* influenza, dengue, yellow fever, plague, paratyphoid fever, Mediterranean spotted fever, African tick-bite fever, Rocky Mountain spotted fever
- *10 to 21 days:* malaria, viral hemorrhagic fevers, typhoid fever, scrub typhus, Q fever, relapsing fever caused by *Borrelia* organisms, African trypanosomiasis
- *More than 21 days:* malaria, filariasis, brucellosis, hepatitis (A, B, C, E), rabies, schistosomiasis, leishmaniasis, amoebic liver abscess, tuberculosis

COUGH

Cough is a common symptom. It is commonly associated with an upper respiratory infection, but can also be due to throat irritation, drug side effect, sinusitis, bronchitis (see page 205), serious infectious disease (e.g., pneumonia—see page 48), asthma (see page), heart failure (fluid in the lungs—see page 47), reflux esophagitis (“heartburn”—see page 221), allergy, or high-altitude pulmonary edema (see page 340).

Treatment of cough depends on the cause. For instance, the cough associated with asthma requires that the asthma be properly treated. For the cough associated with a minor upper respiratory infection, usually viral, cough medicine may be helpful. Some suggested remedies are listed on page . One favored by experts is dextbrompheniramine 6 mg plus pseudoephedrine 120 mg twice daily for 1 week. An alternative is ipratropium 0.06% nasal spray, two sprays per nostril 3 to 4 times daily for 2 weeks. **A U.S. FOOD AND DRUG ADMINISTRATION ADVISORY PANEL IN 2007 RECOMMENDED THAT THERE IS NO EVIDENCE THAT OVER-THE-COUNTER COLD AND COUGH MEDICINES WORK IN CHILDREN AND THAT THE PRODUCTS SHOULD NOT BE GIVEN TO CHILDREN YOUNGER THAN 6 YEARS OF AGE.** Children ages 2 to 18 years may benefit from one or two teaspoonsful of buckwheat honey for treatment of nocturnal (nighttime) coughing. *It is not advised to feed honey to infants or children under age 12 months because of the risk for infant botulism.*

Whooping cough (pertussis) is a highly communicable infectious disease caused by the bacterium *Bordetella pertussis*. It is transmitted by respiratory secretions or large droplets from the respiratory tract of an infected person. In children, whooping cough is typified by coughing episodes that are sudden, intense, and sometimes accompanied by vomiting and inspiratory “whoops,” indicating throat spasms on inhalation. It is not uncommon for the victim to

cough in severe spells and to have gagging or vomiting after a coughing spell. In adults, it most commonly presents like a common cold for a week or two (this is the most infectious period), followed by a mild cough that becomes progressively severe. The cough is as described in children and may also involve difficulty breathing. Untreated, the cough may last for 6 to 10 weeks in children and for more than 10 weeks in adults. If this diagnosis is made, the victim should be treated with azithromycin (10 mg/kg of body weight [not to exceed 250 mg] by mouth once a day on day 1, then 5 mg/kg on days 2 through 5 for children; 500 mg day 1, then 250 mg days 2 through 5 for adults); erythromycin (40 to 50 mg/kg per day in 4 divided doses [not to exceed 2 g per day] for 14 days for children; 500 mg 4 times a day for 14 days for adults); clarithromycin (15 mg/kg per day in 2 divided doses [not to exceed 1 g per day] for 7 days for children; 500 mg twice a day for 7 days for adults); or with trimethoprim-sulfamethoxazole (8 mg/40 mg per kilogram per day in 2 divided doses for 14 days for children; 160 mg/800 mg twice daily for 14 days for adults). The protective effect of DTaP (diphtheria-tetanus-pertussis) vaccine wanes rapidly 3 to 4 years after the last dose, so adults remain vulnerable to the disease.

Croup is a disease of children, rarely noted in adults, in which there is hoarseness, raspy breathing on inhalation, and a seal-like, barking cough associated with narrowing of the soft tissues of the larynx. If croup is suspected, the victim should be given a single oral dose of a corticosteroid, such as dexamethasone (0.6 mg/kg [2.2 lb] body weight for a child, up to 4 mg total dose; 4 mg for an adult). While some support the home remedy of breathing cool air, there is no evidence that breathing cool air, warm air, or humidified air makes any difference in resolving the illness. If croup is very severe, a health care practitioner may administer inhaled epinephrine.

COUGHING BLOOD

The blood coughed up by a victim may have originated anywhere from the mouth to the lungs. Causes of coughing blood include the following:

Sore Throat

The victim will complain of an irritated throat and difficulty swallowing, and will cough up whitish phlegm streaked with blood. If the victim is not short of breath and is not in distress, rapid medical attention is not necessary (see page 46). Similarly, if a person has a nosebleed, he may cough and spit a lot of blood (see page 192).

Pneumonia

The victim will complain of fever, chills, chest pain, and shortness of breath. He will cough up green or rust-colored thick sputum (see page 48).

Pulmonary Embolism

The victim will complain of difficult and painful breathing, shortness of breath, agitation, and weakness. Generally, only severely ill persons will cough up small clots of blood (see page 46).

Lung Cancer

The victim will suddenly cough up small pieces of spongy lung tissue or tumor, along with blood clots. Attend to the airway (see page 22) and seek medical attention.

Lung Injury

If a victim is struck in the chest, and particularly if his ribs are broken, the underlying lung can be bruised or torn. The victim will cough up small clots of blood or, if the injury is major, mouthfuls of blood. This is extremely serious and requires constant attention to the airway (see pages 22 and 42).

DIZZINESS

Dizziness is a feeling of lightheadedness, with or without a sensation of spinning (vertigo). It often precedes a fainting episode (see page 165) or may accompany a stroke (see page 144), heart attack (see page 50), low blood sugar (see page 142), heat illness (see page 322), ear infection (see page 175), the bends (see page 403), plant poisoning (see page 416), motion sickness (see page 440), and many other disorders. Frequently, dizziness is caused by an infection or disorder of the middle ear, which controls balance. Indeed, if the external ear canals are blocked by wax, this alone can cause dizziness.

If a victim is dizzy, he should lie on his back and attempt to regain orientation to his surroundings. Examine him for obvious causes and treat accordingly. If the dizziness does not resolve, and particularly if the victim is elderly (in which case it might indicate a stroke), he should be taken to a physician. True vertigo is very distressing to the victim and described by him as “the room spinning around,” with nausea and/or vomiting, weakness, ringing in the ears (tinnitus), and occasional slow jerking or fluttering movements of the eyeballs (nystagmus). Benign sudden positional vertigo may be caused by free-floating calcium carbonate crystals in the inner ear. Inflammation of the inner ear (often associated with a recent cold) is known as vestibular neuritis (“labyrinthitis”). It is treated with the same medications used for motion sickness (see page 440). In addition, a 3-week taper of a corticosteroid (such as methylprednisolone) in a starting dose similar to that for a severe poison oak rash (see page 232) may hasten recovery. Antiviral agents have not been proven effective for this condition. The benzodiazepine

class of drugs (including lorazepam or clonazepam 0.5 mg by mouth twice a day, or diazepam 2 to 5 mg by mouth every 6 hours as needed) may be useful to suppress vertigo, but carry the side effect of sedation. Vestibular neuronitis is a diagnosis to be reached by a physician after more serious problems are excluded.

HICCUGHS

Hiccoughs can be extremely annoying. A few tricks for stopping them include immersing the face in ice water, swallowing in a series of 10 sips without interruption, and hyperventilating for a moment. If none of these work, gently sliding a well-greased length of thin, flexible rubber tubing through one nostril to the point where it just barely touches the back of the throat may terminate the hiccoughs. This must be done while taking care not to injure the sensitive interior lining of the nose.



HEAD (ALSO EYE, EAR, NOSE, THROAT, AND MOUTH)

HEADACHE

Tension or fatigue headache is characterized by throbbing pain in the temples, over the eyes, and in the posterior neck and shoulder muscles. It can be treated with rest, sunglasses, and moderate pain medication, such as aspirin or acetaminophen every 3 to 4 hours. Sometimes, applying warm packs or massage to tense muscles relaxes them and helps relieve the pain.

Migraine headache is generally more severe. It is defined as episodic attacks of headache lasting 4 to 72 hours and characterized by at least two of the following: moderate to severe intensity, one-sided pain, throbbing or “pulsating,” and worsening with movement. In addition, there is nausea or vomiting (which may be treated with metoclopramide [Reglan] 10 mg by mouth or with ondansetron [Zofran] 4 mg oral dissolving tablet), and aversion to light or sound. Migraine headache is currently thought to be caused by painful dilation of small arteries

in the head. Migraine headaches have many variations, which may include stuffy or runny nose and weakness of an arm or a leg. Some people experience an “aura” before the “classic” migraine headache, in which they may smell strange odors or see flashing lights. Others develop tunnel vision—diminished peripheral vision. The headaches are characterized as excruciating, pounding, or explosive. Occasionally they will respond to nonsteroidal antiinflammatory medications, such as ibuprofen, but often require stronger pain medications and sometimes may need to be treated with narcotics. A person suffering from a migraine should be placed in a quiet, dark area to minimize external stimuli. He should be encouraged to drink enough liquid to treat or prevent dehydration and offered ibuprofen, acetaminophen, or aspirin. Caffeine may be helpful.

Specific antimigraine medications include the “triptans,” such as sumatriptan (Imitrex), naratriptan (Amerge), rizatriptan (Maxalt), and zolmitriptan (Zomig). These medications should be given as early as possible in the course of the headache to achieve maximal effectiveness. Other medicines that are effective include propranolol or metoprolol, amitriptyline, methysergide, flunarizine, and prochlorperazine (Compazine) given with diphenhydramine (Benadryl). Ergotamine drugs (such as dihydroergotamine mesylate [Migranal] nasal spray) directly constrict arteries; these should only be used under the direct supervision of a physician, since they may worsen the effects of certain types of migraines. If an oxygen (see page 431) tank is available, the victim may get some relief by breathing 10 liters per minute by face mask. An elderly person with a severe migraine, which may be confused with a stroke (see page 144), should seek immediate medical attention. A migraine headache may be precipitated by lack of sleep, high altitude, emotional stress, cyclical hormone changes, noxious odors, and certain ingested substances (such as caffeine and monosodium glutamate). Therefore, the migraine sufferer should seek to obtain regular sleep (go to bed and wake up at the same times every day), rest, and meals (do not skip or delay); limit caffeine consumption to the equivalent of two cups of coffee or two 12-ounce sodas per day; avoid tobacco products; avoid known personal triggers (e.g., red wine); practice relaxation techniques; and strive to maintain fitness through regular exercise and dietary discretion. For certain sufferers, a neurologist may prescribe topiramate (Topamax) to be taken between episodes of migraine to reduce the frequency of headaches.

Sinus headache is associated with sinus infection (see page 194) and is typified by fever, nasal congestion, production of a foul nasal discharge, and pain produced by tapping over the affected sinus(es). It should be treated with an oral decongestant (pseudoephedrine), nasal spray (Neo-Synephrine 0.25% or Afrin 0.05%), an antibiotic (azithromycin, amoxicillin-clavulanate, erythromycin, or ampicillin) if an infection is present, and warm packs applied over the affected sinus(es).

Subarachnoid hemorrhage is bleeding that occurs, usually suddenly, from a leaking blood vessel (commonly an aneurysm) underneath the thin tissue layer that surrounds the brain and spinal cord. The headache is usually sudden in

onset, described as “the worst headache of my life,” and may be associated with a fainting spell, altered mental status, seizure, and collapse. If a person suffers a subarachnoid hemorrhage and remains awake, he may complain of a stiff or painful neck with or without back pain about 2 to 4 hours after the bleed. Anyone who complains of a severe headache after extreme physical straining (such as weight lifting or a difficult bowel movement) or who collapses suddenly after reporting a headache should be suspected to have suffered a subarachnoid hemorrhage and be brought rapidly to a hospital.

Meningitis, an infection that involves the lining of the brain and spinal cord, is a true emergency. The headache of meningitis is severe, and often accompanied by nausea, vomiting, photophobia, fever, altered mental status, and weakness. A purplish skin rash indicates infection with the bacteria *Neisseria meningitidis*, a particularly fulminant and contagious form (“meningococcal”) of infectious meningitis. The classic signs of meningitis are a stiff neck with a fever. The victim demonstrates extreme discomfort when the chin is flexed downward against the chest, and may complain that the pain also occurs in the back (along the course of the spinal cord). It is important to note that an infant can suffer meningitis without a stiff neck and may present only with poor feeding, fever, vomiting, seizures, and extreme lethargy (“floppy baby”). If meningitis is suspected, the victim must be evacuated rapidly. If antibiotics are available, the recommendations currently given to doctors for antibiotics are as follows: age 16 to 50 years, vancomycin plus either cefotaxime or ceftriaxone; age greater than 50 years, vancomycin plus either cefotaxime or ceftriaxone, as well as ampicillin.

Giant cell arteritis is a type of inflammation that occurs in elders that can affect the temporal artery, which travels in a path along the sides of the scalp over the ears (temples). The associated headache may be quite severe and accompanied by thickened and tender arteries that may be noticeably enlarged with or without overlying reddened skin. Pulses may or may not be appreciated in these arteries, and the victim may have pain radiating down the side of the face as low as into the jaw. Permanent partial or complete loss of vision may occur in one or both eyes, which makes this condition an emergency. This condition is frequently associated with the disorder polymyalgia rheumatica. The immediate treatment is administration of a corticosteroid, such as prednisone 40 to 60 mg by mouth each day until a physician can evaluate the patient.

A headache that is atypically severe or prolonged may represent a serious problem, such as accelerated (out of control) high blood pressure (hypertension), brain tumor, infection, glaucoma, blood clot within the brain, carbon monoxide poisoning, inflammation of the temporal artery, or hemorrhage. The victim should be evaluated by a physician at the earliest opportunity. If a person develops a severe headache associated with a fainting spell or stiff neck, or is known to suffer from high blood pressure, keep him as calm as possible and urgently seek assistance. If high blood pressure is known to be the problem, and the victim is taking antihypertensive drugs, he should be advised to avoid using medications or other substances that might counteract the effects of his antihypertensives. These include ephedra, phenylephrine, certain herbal

supplements (such as ginseng and yohimbine), appetite suppressants, anabolic steroids, and certain nonsteroidal antiinflammatory drugs.

In general, *particularly worrisome headaches* include a single headache that is the “first” or “worst” of a person’s life; headache with a fever that is not explained by an obvious illness; headache with vomiting that is not explained by an obvious illness; headache associated with a neurologic sign, such as weakness or altered speech; headache associated with altered mental status; headache associated with neck pain when the chin is flexed to the chest; progressively worsening headache; sudden headache in an elder; headache in someone suffering from cancer; headache after a blow to the head; headache following an episode of loss of consciousness; or headache in someone suffering from immunosuppression.

BELL’S PALSY

Bell’s palsy is a form of facial paralysis caused by a problem with a specific nerve (the seventh [facial] cranial nerve) that supplies the face. It is rapid in onset, and can cause the muscles of one side of the face to be completely paralyzed less than 2 days after the first weakness is noted. There is usually no pain except perhaps a slight discomfort behind the ear on the affected side. This pain may appear a day or two before the weakness. Bell’s palsy may mimic a stroke. With Bell’s palsy, the muscles of the forehead are affected. If they are not, the victim should be immediately evacuated for a full medical evaluation. The cause of Bell’s palsy may be involvement of the nerve with the herpes virus. The current recommendation is to treat with prednisone 1 mg/kg (2.2 lb) of body weight by mouth per day for 7 to 10 days. It is somewhat more controversial to also treat with the antiviral drug acyclovir (800 mg by mouth 5 times a day for 7 days). It is also important to protect the eye if the victim cannot close his eye or blink. The eye can be patched or gently taped closed to protect the cornea.

EAR

Earache

An earache may be caused by infection, injury, or a foreign body in the ear. For a discussion of ear squeeze (barotitis) that occurs with scuba diving, see page 404.

Ear Infection

Ear infection can be either internal (otitis media) or external (otitis externa) to the eardrum (tympanic membrane) (Figure 107).

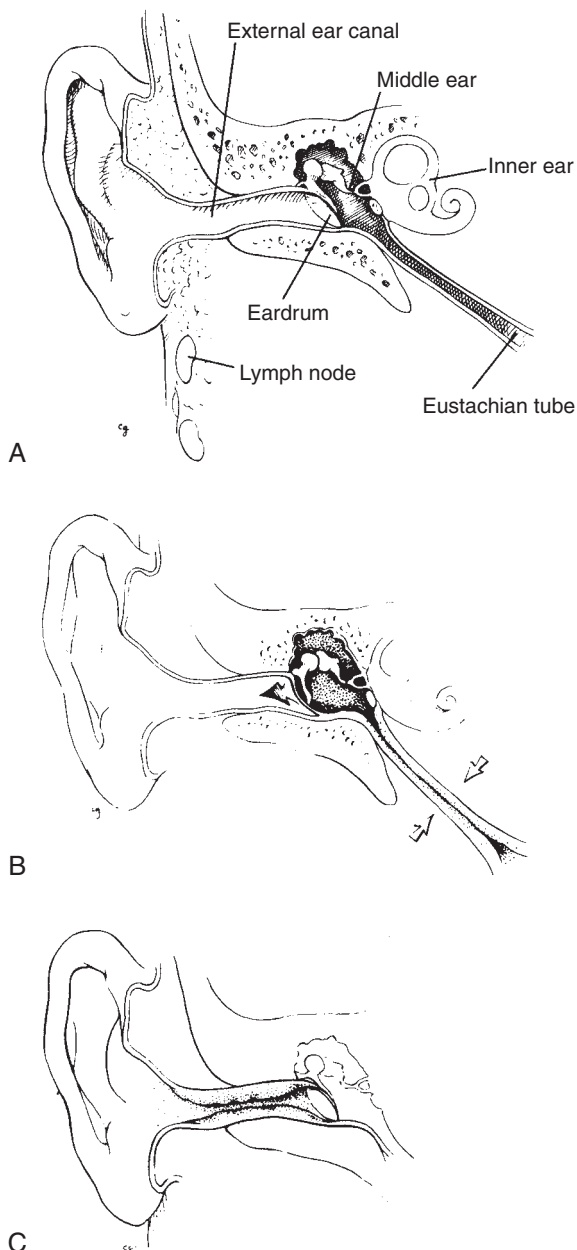


Figure 107. Ear infections. **A,** Normal ear anatomy. **B,** Otitis media (inner ear infection). The eardrum bulges outward as the middle ear fills with fluid. The eustachian tube narrows or closes. **C,** Otitis externa (external ear canal infection). The canal becomes swollen and drains pus.

Otitis media. Infection may occur that reddens and inflames the eardrum and causes blood, serum, or pus to collect behind the drum (see Figure 107, B). With otitis media (middle ear infection), there is no drainage from the external ear canal (unless the eardrum ruptures, which is unusual in an adult, although more common in a child) and the victim has a fever, often with a sore throat. In many cases, the victim has a history of prior infections. Most often, otitis media occurs in children; when it occurs in an adult, it may be associated with a sinus infection or functional obstruction of the eustachian tube (the pressure-release mechanism from the middle ear into the throat). A young child can rapidly become severely ill from otitis media; an infant may develop meningitis (see page 174) following an ear infection. It is interesting to note that children who chew sugarless gum containing xylitol (or who ingest syrup or granules containing xylitol), which is derived from birch trees, may have fewer ear infections. This is supposedly because xylitol inhibits the growth of certain bacteria that cause the infections. It is reasonable to advise children prone to ear infections to avoid sugar-containing gum or candies.

Although many cases of otitis media in children are caused by viruses, such as respiratory syncytial virus, and resolve without antibiotic treatment, if you are distant from physician care and suspect otitis media, treat the child victim with an antibiotic. Adults and children should be treated with amoxicillin (80 to 100 mg/kg [2.2 lb] of body weight per day in three divided doses), amoxicillin-clavulanate (same dose of the amoxicillin component as for amoxicillin), cefdinir (14 mg/kg once daily or in 2 divided doses), cefpodoxime (10 mg/kg once daily or in two divided doses), cefuroxime (15 mg/kg in two divided doses), or clarithromycin for 10 days, or with azithromycin for 5 days. An additional antibiotic choice for children is erythromycin-sulfisoxazole for 10 days. Other antibiotics that have been approved for treatment are cephalexin, cefprozil, loracarbef, and ceftibuten. Aspirin, ibuprofen, or acetaminophen should be used to control fever. *To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.*

Otitis externa (swimmer's ear). Ear infection, commonly from the bacterium *Pseudomonas aeruginosa*, that develops in the external ear canal (often noted in swimmers and divers who do not keep the canal completely dry) rarely involves the eardrum (see Figure 107, C). When the external canal is kept moist, it is easier for bacteria to invade the skin and cause infection. The earliest symptom may be itching. Subsequent symptoms include a white to yellow-green liquid or cheesy discharge from the ear, pain, and decreased hearing. Occasionally, the victim complains of exquisite tenderness when the earlobe is tugged or the jaw is moved and has tender, swollen lymph glands in the neck on the affected side. In a severe case, the victim may have a fever and appear toxic.

If the victim has only a discharge without fever or swollen lymph glands, he may be treated with ear drops, such as 2% nonaqueous acetic acid (VoSoL or Domeboro Otic). Household vinegar diluted 1:1 with fresh water or with rubbing (isopropyl) alcohol (approximately 70%) can be used as a substitute. These ear drops should be administered four to five times a day and may be retained with a cotton or gauze wick gently placed into the external ear canal, or by using an expanding foam ear sponge (such as a Speedi-Wick, Shippert Medical Technologies). To avoid injuring the eardrum, do not attempt to clean out the ear with a cotton swab or similar object. The solution should be retained in the ear for a minimum of 5 minutes with each application. If there is any suggestion that the eardrum may be punctured (e.g., the presence of bleeding), do not use this solution.

If the victim has a discharge with fever and/or swollen lymph glands, the ear drops should contain hydrocortisone (VoSoL HC); he should also be given oral ciprofloxacin, erythromycin, or penicillin. An ear drop that may be useful is ciprofloxacin with hydrocortisone (Cipro HC otic suspension). Another is ofloxacin otic solution (Floxin otic) 0.3%. These ear drops are used twice a day. If the discharge from the ear is gray or black, a fungal infection may also exist, in which case tolnaftate 1% solution may be added to the treatment regimen. Aspirin, ibuprofen, or acetaminophen should be used to control fever. *To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.*

To prevent swimmer's ear, the external ear canal should be irrigated with VoSoL, Domeboro Otic solution (2% acetic acid, aluminum acetate, sodium acetate, and boric acid) or diluted vinegar/alcohol (described above) after each scuba dive or immersion episode in the water. Keep the solution in the canal for a full 5 minutes before allowing it to drain.

The Sahara DryEar warm air ear dryer is a small, portable device to prevent and treat ear disorders by drying the ear canal. The airflow from this device runs for 80 seconds at a comfortable temperature and dries the outer ear canal. The device has a customized computer chip that directs a heater and fan to regulate the flow of warm air into the ear canal. The DryEar is equipped with a rechargeable lithium ion battery and can run 50 times before requiring a recharge. The device is not waterproof, so one must take care when carrying it near the water, and it should be stored in a safe, dry location.

Referred Pain

"Referred" pain is pain that appears in one body region but actually originates in another. This occurs because different body regions are supplied with nerves that share common central pathways. In the case of ear pain, the cause may be a sore throat, tooth infection, or arthritic jaw. The ear pain will not disappear until the underlying cause is corrected.

Injury to the Eardrum

If something is poked into the ear, a hard blow is struck to the external ear, a diver descends rapidly without equalizing the pressure in his middle ear (see page 404), or a person is subjected to a loud explosive noise, the eardrum may be ruptured. This causes immediate intense pain and possibly loss of hearing, along with occasional nausea, vomiting, and dizziness. If the eardrum is ruptured, cover the external ear to prevent the ingress of dirt, and seek the aid of a physician. If debris has entered the ear, start the victim on penicillin or erythromycin by mouth. Do not put liquid medicine into the ear if you suspect that the eardrum is ruptured. If the dizziness is disabling, administer medicine for motion sickness (see page 440). Use appropriate pain medication.

Foreign Body in the Ear

A foreign body in the ear can be incredibly painful, particularly if it is dancing on the eardrum or resting against the sensitive lining of the ear canal. An inanimate foreign body (a piece of corn, peanut, foxtail, stone, or the like) can be left in the ear until an ear specialist with special forceps can remove it. If a live creature (cockroach, bee) enters the external ear canal and causes pain that is intolerable, the ear should be filled with 2% to 4% liquid lidocaine (topical anesthetic), which will (slowly) numb the ear and drown the bug at the same time. If lidocaine is not available, mineral oil can be used, with the caution that it will frequently cause the insect to struggle, which may encourage a sting or bite and incredible temporary pain. Once the animal is dead (a few minutes), a gentle attempt should be made with small tweezers to remove it. Don't attempt this unless you can see part of the bug, however. Don't push the bug in farther, or you might rupture the eardrum.

Wax in the Ear

If hearing is diminished in an ear because of a wax plug, the wax must first be softened with a solution such as Cerumenex or Debrox. Another useful wax softener is docusate sodium (Colace) solution. Put a few drops in the ear (retained by a wick or cotton) four to five times a day for 1 to 3 days. This will turn hard ear wax into mush. If none of these is available, household hydrogen peroxide might work. Then use a forceful stream of lukewarm water to flush out the wax. You can fashion a flushing device by attaching a plastic 18-gauge intravenous catheter (without the needle) to an 8 to 30 mL syringe. Don't try to clean out the ear with a cotton-tipped swab or other rigid object, because you may force the wax down deeper, perforate the eardrum, or scrape and cut the exquisitely sensitive skin that lines the external ear canal, setting up an infection.

EYE

A proper eye examination is composed of an inspection for obvious injury to the eye or soft tissues surrounding the eye, assessment of the ability to see (visual acuity), muscular motion of the eyes, pupils for size and equality, and the presence of blood or pus underneath the cornea. To check visual acuity, have the victim read something, one eye at a time, at a distance of about 16 inches. If the person uses glasses, have him wear them.

Chemical Injury to the Eye

A chemical burn of the eye is a true emergency. If any acid, alkali, spitting cobra venom, skunk musk, or other chemical irritant is splashed into the eye, immediately flush the eye with cool water. Assist the victim in holding the eyelids open. Continue the irrigation for at least 30 minutes. Do not patch the eye closed, and seek immediate medical attention. If you are far from care, inspect the eye carefully for retained particles and remove them with a moistened cotton-tipped swab. Administer ofloxacin (Ocuflax) ophthalmic solution 0.3%, moxifloxacin 0.5% (Vigamox), or gatifloxacin 0.3% (Zymar) (1 to 2 drops 4 times a day) until the eye is healed.

If “superglue” comes in contact with the eyelids and they become glued shut, gently try to pull them apart. If this is not possible, apply Neosporin or bacitracin ointment to the eyelid margins and cover the eye with a patch. In 24 to 48 hours, the glue should dissolve and soften to allow the eyelids to separate. Do not use “superglue remover,” which may contain acetone and is harmful to the cornea (clear surface of the eye). If antiseptic ointment is not available, patch the eye closed overnight with the eyepads presoaked with water. This may loosen the bond and allow the eyelids to be separated.

Foreign Body under the Eyelid and Scratched Cornea; Corneal Ulcer

If a foreign body lodges on the cornea (the clear surface of the eye) without actual penetration of the eyeball, irrigate the eye copiously with an eyewash solution (use water if you do not have eyewash). If this is not successful, have the victim look downward, grasp his upper lid firmly by the eyelashes, and fold it up and inside out over a cotton swab (Figure 108). You can lightly grease the swab with antiseptic ointment to keep it from sticking to the skin. If you can see the foreign body on the undersurface of the upper eyelid, gently wipe it away with a cotton swab or piece of moistened cloth. If you do not see the object, check between the lower eyelid and the eyeball. After the inspection, pull down on the eyelashes to unfold the lid.

Once you have removed the object, if the victim still feels as if something is in his eye, he may have suffered a scratch on the cornea (corneal abrasion). In this case, it may help control the discomfort to patch the eye closed for 24 hours. However, *never patch an eye closed if there is any sign of an active infection* (pus or

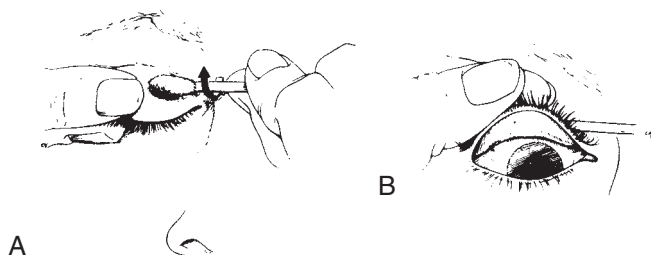


Figure 108. Eversion of the eyelid to locate a foreign body. **A**, The lid is grasped and pulled over a cotton swab or small blunt stick. **B**, The underside of the eyelid is inspected for a foreign body while the victim looks downward.

discharge). When the patch is removed, if there is residual pain, a gritty sensation, gooey discharge, or blurred vision, see a doctor as soon as possible. Tiny objects, such as the spine of a horse nettle (sand brier), can become embedded in the cornea and not be visible without the magnification available to an ophthalmologist.

To patch an eye, a $\frac{1}{2}$ in (1.3 cm) thick pad of soft cloth or bandage should be shaped to fit neatly over the eye socket, and affixed snugly to the face with tape or bandages extending across the patch onto the cheek below and the forehead opposite the affected eye (Figure 109). Prepackaged sterile elliptical eye pads are available. If only tape is available, the eyelids may be taped closed with a single small piece of tape.

Another way to hold an eye shield, patch, or padding around the eye is with a cravat (see page 277). First, place a strip of cloth approximately 2 in (5 cm) wide and 15 in (38 cm) long over the top of the head front-to-back, so that the face-side end hangs over the uninjured eye, near the nose. Place the patch, pad, or shield over the eye and hold it in place with a cravat, which should be wrapped horizontally around the head and then tied in position on top of the hanging cloth strip. Make the first tie (single loop or half square knot) in the cravat behind the head and at the base of the skull, and keep wrapping it around, to complete the final tie



Figure 109. Taping a patch over the eye.

(square knot) where the ends meet. If the final tie will be over an eye, shift the cravat. Pull up the ends of the hanging cloth strip and tie them at the top of the head; this should lift the cravat up off the uninjured eye (Figure 110).

If the eye cannot be patched, sunglasses should be worn. For a scratched cornea, administer an antibiotic in the affected eye until it is healed, which usually occurs in 3 to 5 days. Use ofloxacin (Ocuflox) ophthalmic solution 0.3%, moxifloxacin 0.5% (Vigamox), or gatifloxacin 0.3% (Zymar) one or two drops to the affected eye every 3 to 4 hours, or a ribbon of erythromycin ophthalmic ointment every 6 hours.

A corneal ulcer is a serious erosion, usually caused by a bacterial infection, that causes a “red eye,” pain, and sometimes decreased visual acuity. It may follow a scratched cornea. The white of the eye is very reddened and if you look closely, you may notice a small, round white or yellowish spot on the surface of the cornea. This is an emergency, because the ulcer may spread rapidly and cause permanent damage. If a corneal ulcer is suspected, immediately use ofloxacin (Ocuflox) ophthalmic solution 0.3%, gatifloxacin 0.3% (Zymar), or moxifloxacin 0.5% (Vigamox) two drops to the affected eye every 2 hours and seek immediate medical attention. *Do not patch the eye if a corneal ulcer is seen or suspected.*

Injured Eyeball

If the eyeball is perforated, there will be a combination of loss of vision (ranging from hazy vision to blindness), pain, excessive tearing, a dilated pupil, and visible blood in the eye. There may be gelatinous material extruding from the eye, and the pupil will be irregular or jagged in appearance. Do not attempt to rinse out the wound vigorously; remove obvious dirt and debris without placing any pressure on the eye. Close the eyelid gently and cover the eye with a protective shield. This can be fashioned by cutting gauze pads or soft cloth to the proper size, or by fashioning a doughnut-shaped shield with a cloth, cravat bandage, or shirt (Figure 111). An-



Figure 110. Holding an eye patch in place with a cravat. Hang a cloth strip over the uninjured eye. Hold the patch in place with a cravat. Tie the cloth strip to lift the cravat off the uninjured eye.

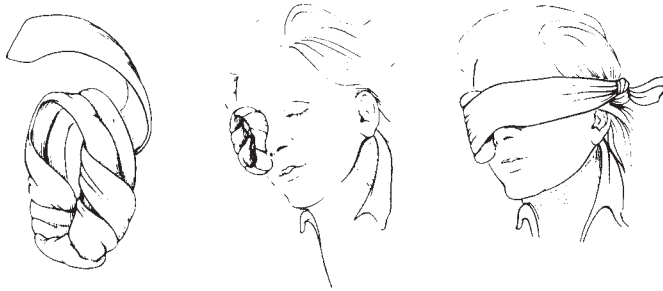


Figure 111. Bandage for the injured eye. A cravat or cloth is rolled and wrapped to make a doughnut-shaped shield, which is fixed in place over the eye.

other good way to keep pressure off the eye is to cut an eye-sized hole in a stack of gauze pads and place the stack over the eye, taping or wrapping it in place. An eye shield can also be improvised by cutting off the bottom 2 in (5 cm) of a paper cup and taping it over the eye. Metal or plastic preshaped eye shields can be carried.

Do not exert pressure on the eyeball, because this can increase the damage. Instruct the victim to keep both eyes closed, and start him on ciprofloxacin, penicillin, doxycycline, cephalexin, or erythromycin. Seek immediate medical attention.

Bleeding into the Eye

If the eyeball has been struck (not torn or ruptured), there may be bleeding from small blood vessels within the eye into the clear liquid that fills the space directly behind the cornea and in front of the lens. Such bleeding is called a hyphema. It first appears as diffuse bloody (red) clouding of the fluid behind the cornea, which settles over the course of 6 to 8 hours into a clearly visible layer of blood (Figure 112). If such a condition is noted, the victim should have his eye patched closed (see the previous section) or wear sunglasses; he should be transported to an eye doctor. If possible, keep his head elevated and in an upright position and apply a rigid eye shield to protect the eye from being struck. The victim should avoid straining.

Removing Contact Lenses

If a victim is severely injured and he is wearing contact lenses, they should be removed. A contact lens remover may be used, or a slightly sticky surface of mini-marshmallow can be placed carefully against the lens to grasp it. Either soft or hard lenses can be removed by the following technique (Figure 113):

1. Slide the lens off the clear surface of the eye (cornea) over to the white area away from the nose.
2. Place one finger at the outside edge of the lower eyelid and pull the eyelid taut, while keeping the eye slightly open. This should lift the edge of the

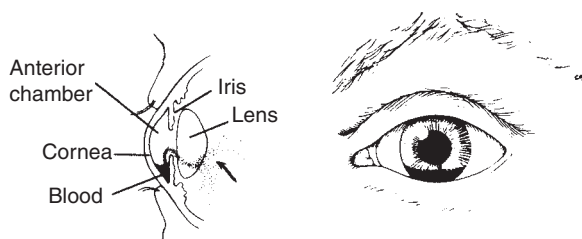


Figure 112. Hyphema. Bleeding into the eye causes an accumulation of blood in the anterior chamber, where it settles into a layer behind the cornea. In severe cases, the pupil is obscured by red blood.

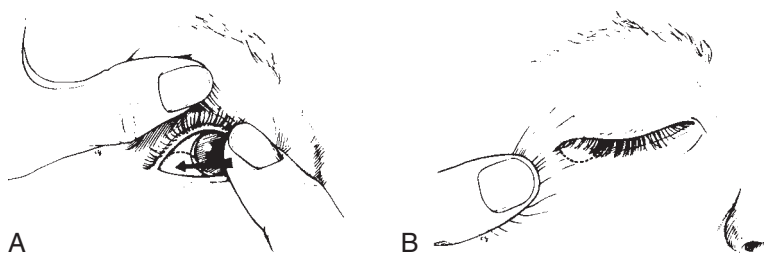


Figure 113. Contact lens removal. **A**, Push the lens gently to the lateral (away from the nose) white portion of the eye. **B**, A downward and outward pull on the skin at the lateral corner of the eye pops the lens free.

lens, so that you can pick it up. If you cannot remove the lens, position it so that as much as possible is over the white (and not on the cornea).

3. Place the lens in a container with contact lens solution, eyewash, or water (if possible, add 1 tsp, or 5 mL, of table salt per pint, or 473 mL, of water).
4. A soft contact lens can often be removed by simply pinching it gently between your thumb and index finger.

If you cannot remove a contact lens, it is best to close the eye gently, place a soft cloth or gauze pad patch over it, and tape it closed. Be certain that someone knows why this has been done (i.e., the lens is still in the person's eye).

Subconjunctival Hemorrhage

Bleeding into the white of the eye (subconjunctival hemorrhage) may occur spontaneously or after coughing, straining (vigorous exertion), vomiting, or strangulation (Figure 114). The bleeding is painless, does not interfere with vision (the cornea is not involved), and does not require any therapy. The blood will absorb over a period of a few weeks, as from any other bruise. If it does not, seek the care of an eye doctor.

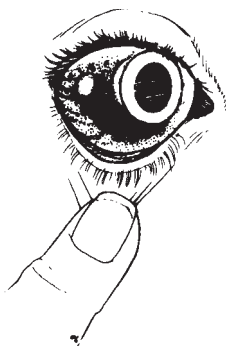


Figure 114. Subconjunctival hemorrhage. The red discoloration does not involve the cornea, which remains clear.

Red Eye

A red or pink, itchy eye is usually caused by a viral infection. Other causes include bacterial infection, insect bite or sting, allergy (see page 205), overuse of contact lenses, corneal abrasion or ulcer (see page 180), foreign body (see page 180), irritation from chemicals or smoke, snow blindness (see page 187), glaucoma (see page 190), or injury (see page 182). If the infection is caused by a virus or bacteria, symptoms include itching, tearing, watery (viral) or thick (bacterial) discharge (runny yellow or greenish pus), crusted eyelashes and lids, and swollen eyelids, which are often stuck together on awakening in the morning. You may notice a swollen lymph gland in front of the ear. If fluid collects underneath the loosely attached (to the eyeball) conjunctiva (membrane-like external lining of the eyeball), it may cause it to swell up and balloon away from the eyeball.

If the cause is a known allergy or irritation from smoke, use eyedrops with 0.025% oxymetazoline (OcuClear, Visine L.R.); antazoline phosphate 0.5% and naphazoline 0.05% (Vasocon-A); or tetrahydrolozine (Visine).

If there is much yellowish discharge, suspect a bacterial infection and administer antibiotic eyedrops (moxifloxacin 0.5%, tobramycin or gentamicin 0.3%, ofloxacin 0.3%, or sodium sulamyd 10%); the dose is two drops every 2 hours for 4 to 5 days while the victim is awake. Never use steroid-containing eyedrops unless directed to do so by a physician. Antibacterial ointments are messy and may blur vision.

Viral conjunctivitis is very contagious, so the victim should be advised to avoid close contact with others, including sharing towels or swimming in shared pools, for 2 weeks after the onset of the infection.

“Pink Eye” and Contact Lenses

“Pink eye” usually refers to a viral infection that causes redness, often accompanied by itching and a thick, yellow or green discharge. Often the lids are stuck together in the morning after sleeping. This viral conjunctivitis is believed to be highly contagious, so the sufferer should take care to not share his implements

of facial washing and drying. It is not uncommon to have “pink eye” develop in one eye and then rapidly be spread to the other eye, presumably because of touching the infected eye and then transferring the infection.

Serious eye infections can be caused by fungus, such as that of the genus *Fusarium*, which has been discovered to grow in contact lens solution. Some experts believe that multipurpose solutions in general are more prone to transmitting infection, for reasons that have yet to be clearly determined.

Regardless of whether or not multipurpose solutions are riskier than single-purpose solutions, outdoor enthusiasts should note that contact lenses may be more difficult to manage in a wilderness environment for the following reasons:

1. Should a contact lens become displaced (e.g., fall out of the eye), it may be more easily lost than eyeglasses.
2. Contact lens solution can degrade or become contaminated by exposure to extreme temperatures, dehydration, or passing over dust and dirt that can accumulate on the threads of bottle caps.
3. Handling contact lenses with dirty hands can introduce bacteria and fungi to lenses or tissues of the eyes.
4. It may not be easy to change out contact lenses quickly if needed for a different refraction or environmental (e.g., sun or wind exposure) condition.
5. Once an eye becomes infected, contact lenses must be removed. They should not be reused if removed because of infection.

For these reasons, it's important to carry at least one, and preferably two, pairs of eyeglasses. If you need reading glasses, carry these as well. Also, be sure that you have sunglasses that block out as much ultraviolet light as possible. Include side shields if you are going to be at high altitude, on snowfields, on the water's surface, or traversing other highly reflective terrain, such as bright sand.

Dry Eyes

Dry eyes are common in dry environments, after prolonged exposure to wind, at high altitude, and associated with certain medical conditions in which tear production is diminished. Artificial tears, such as carboxymethylcellulose sodium 0.5% (Refresh Tears), or lubricating ointment (e.g., Lacri-Lube, containing mineral oil, white petrolatum, and lanolin alcohols) or gel (e.g., Refresh Liquigel, containing carboxymethylcellulose) may be soothing. In the event that dry eyes persist despite administration of artificial tears, an ophthalmologist may prescribe cyclosporine (Restasis), an antiinflammatory medication that has been shown to increase the production of the recipient's own tears, and to relieve symptoms within 3 to 4 weeks.

Blepharitis

Blepharitis is usually a chronic flaking and irritation of the skin at the base of the eyelashes, affecting both eyes. It may become infected, and be accompanied by fluctuating vision, itchy and burning eyes, and mucous discharge on awakening.

Treatment is the application of bacitracin or erythromycin ophthalmic ointment thinly to the lid margins at bedtime for 4 weeks. Warm, moist compresses should be used a few times a day for 5 to 10 minutes at a time to loosen the debris, which is then gently wiped away. Artificial tears are useful to lessen the sensation of dry eyes.

Snow Blindness

Exposure to ultraviolet radiation (UVR) from the sun can lead to a “sunburn” of the cornea (clear surface of the eye). This occurs when proper precautions are not used at high altitudes, where a greater amount of unfiltered (by the atmosphere) ultraviolet radiation is present; the exposure may be compounded by reflection from the snow. The intensity of ultraviolet energy increases by a factor of 4% to 6% for every 1,000 ft (305 m) increase in altitude above sea level. Snow reflects 85% of ultraviolet B (UVB, the culprit wavelengths that cause snow blindness); dry sand reflects 17%, and grass or sandy turf reflects 2.5%. Water may reflect 10% to 30% of ultraviolet B, depending on the time of day and location.

The cornea absorbs ultraviolet radiation below 300 nanometers (nm), which includes a fair portion of UVB. Radiation of wavelengths longer than 300 nm is transmitted to the lens and, over time, can cause cataracts.

High exposure to UVB can cause a corneal burn within 1 hour, although symptoms may not become apparent for 6 to 12 hours. Symptoms include excessive tearing, pain, redness, swollen eyelids, pain when looking at light, headache, a gritty sensation in the eyes, and decreased (hazy) vision. Similar symptoms occur when the surface of the eye is physically scratched (corneal abrasion). Treatment consists of patching the eye closed (see page 181) after instilling a few drops of ophthalmic antibiotic solution (such as moxifloxacin 0.5%, sodium sulamyd 10%, or gentamicin), because the surface of the cornea will regenerate spontaneously in 24 to 48 hours. It is important to check the eye first for a foreign body (see page 180). After patching, the eye must be rechecked in 24 hours. If the eye appears to be infected with pus, it should be left unpatched; administer a topical antibiotic solution (see page 182) three to four times a day, and have the victim wear sunglasses. Pain medicine should be used as appropriate. If both eyes are involved, only the more severely affected eye should be patched, so that the victim can continue to make his way.

Some people recommend a topical nonsteroidal antiinflammatory or steroid solution to hasten the resolution of snow blindness. In a situation in which the diagnosis is certain and such medication is available, instillation may indeed improve things. However, if a topical steroid is applied to a misdiagnosed bacterial or viral infection—particularly herpes virus—the effect can be to worsen the situation. Since snow blindness is self-limited, the application of a topical steroid is not imperative and best left to an ophthalmologist. A useful nonsteroidal topical solution is ketorolac ophthalmic solution (Acular), one drop four times a day.

Eye Allergies

Seasonal allergies commonly involve the eyes, often causing conjunctivitis. See page 185.

Protective Eyeglasses (Sunglasses)

The wavelengths of sunlight that appear to be most damaging to the eye are blue (400 to 500 nm), ultraviolet A (320 to 400 nm), and ultraviolet B (290 to 320 nm). Ultraviolet C (200 to 290 nm) is filtered out by the ozone layer of the atmosphere. Standards for ultraviolet protection in nonprescription sunglasses are set by the American National Standards Institute (ANSI). These state that such lenses should maintain UV absorption up to 400 nm and block 99.8% of ultraviolet B light and 95% of UVA. Lenses advertised for mountaineering or specifically for ultraviolet protection should meet these standards.

Sunglasses should be equipped with side protectors and, if necessary, optional nose guards. Frames should be prepared with wraparound temples and retaining straps or lanyards. Polycarbonate lenses, which are lightweight, scratch resistant, and shatterproof, can be manufactured to absorb 99% of ultraviolet light. Most recreation supply companies manufacture or carry sunglasses and wraparound goggles that meet ANSI standards.

In general, amber, yellow, orange, brown, and rose lenses filter out blue light and increase the perception of contrast. Green and gray lenses soften glare and transmit a spectrum that does not increase contrast. Glass ambermatic or photochromic lenses (darker in bright sunlight), which contain millions of silver halide crystals, darken when exposed to ultraviolet light close to the visible spectrum. Polarized lenses improve vision by decreasing glare, but this does not decrease exposure to UV light.

Improvised sunglasses can be made by cutting small slits or puncturing pinholes in cardboard or two layers of a strip of duct tape after the adhesive sides have been stuck together. Fashion a shape that will fit across the eyes like a pair of sunglasses; tie in the back with a string attachment. The opening should be just large enough to allow adequate vision. This serves two purposes: limitation of ultraviolet transmission and creation of crude refraction to improve focus in a person who is nearsighted.

Vitreous Detachment

Floaters are small spots, lines, clouds, cobwebs, or veils that move around in the field of vision, especially when the eyes move. They can be in one or both eyes, but usually show up in one eye at a time. They are easiest to see when one looks at the sky or against a plain white background. Floaters are caused by tiny opacities inside the vitreous, which is the gel that fills the inside of the eyes. In childhood and adolescence, the vitreous gel is clear, so that floaters are not seen. In adulthood,

floaters can develop when the vitreous gel forms small clumps as part of the aging process. As light passes from the outside of the eye, through the cornea and lens, and then through the vitreous gel before it strikes the retina to record an image, the floaters can cast shadows on the retina. Floaters are annoying, but not dangerous, particularly if they have been present for a long time.

The sudden appearance of floaters can signify separation of the vitreous gel from the retina, which is the layer of tissue in the back of the eye on which visual images are recorded on specialized receptor cells. This occurs because the vitreous gel shrinks as it ages. If it shrinks enough, it begins to peel away from the retina, in what is called a vitreous separation or detachment. It is more common in nearsighted people and in persons who have had cataract surgery or injuries to their eyes or head. When a vitreous separation occurs, the floaters appear suddenly. As the gel peels away from the retina, it tugs on it, which can cause a person to appreciate flashes of light, usually on the outer (ear) side of the eye. These usually last no more than a second, and are caused by the nerves within the retina (which connect to the large optic nerve) being stimulated mechanically by the tug of the vitreous gel. Flashes are difficult to appreciate in daylight, but can be easily seen in the darkness. Moving the head or eyes can cause the flashes. Since flashes mean that the vitreous is pulling on the retina, this is a warning sign, because the traction can cause a retinal tear. If this happens, an ophthalmologist needs to perform laser surgery as soon as possible to prevent a full-blown retinal detachment.

The normal course for a vitreous separation is a 2- to 4-week process in which the separation is completed. This may be punctuated by intermittent addition of new floaters, but usually the burst of opacities is at the beginning of the process. Over time, most of the floaters diminish or disappear, but there may be some residual floaters. During the course of the separation, when a person first notices the floaters, and if a person suddenly develops new floaters, more frequent flashing lights, or a defect in a field of vision (often described as a “dark curtain”), an ophthalmologist should perform an examination to be certain that there is not a retinal tear or detachment. It is important to avoid sudden eye or head movements for several weeks after the onset of a vitreous separation, to decrease the likelihood of developing a retinal tear or detachment.

If a new vitreous detachment is suspected, it is wise to begin to head toward civilization to undergo a proper eye examination. However, if it is likely that a retinal detachment has occurred (e.g., there is a “field cut,” or a darkened area of vision as if a curtain was being pulled across the field of vision from any direction), it is prudent to evacuate immediately, including a more expensive mode of transportation if necessary, because treatment for retinal detachment is usually an operation by an ophthalmologist, and time is of the essence. A progressive retinal detachment can lead to permanent loss of vision in the affected eye.

In terms of exercise, it is wise to avoid sudden head or eye movements, so no jogging or swimming with rapid head movements, wrestling, significant straining, and so on. Until the vitreous separation process is complete, a person should try to turn the head to look in a direction, rather than hold the head in a fixed position

and move the eyes. All of this may be difficult in a precarious situation, such as rock climbing or kayaking, but one should just do the best he can given the particular circumstances.

Injury to the Retina

The retina is the thin inner posterior-surface tissue layer of the eye, the “screen” on which images are transmitted by light. From the retina, nerves from the eye carry signals to the brain. The retina can be injured by the transmission of unrestricted infrared rays (wavelengths of light beyond the red end of the visible spectrum). Usually, this occurs when someone views the sun directly during an eclipse or when a person stares at the sun while under the influence of hallucinogenic drugs. Symptoms include pain and blindness. If such an injury is suspected, sunglasses should be worn or the eye should be patched. The victim should be transported to an eye doctor.

Occasionally, a structural abnormality, the aging process, or a blow to the eye will cause the retina to become separated from the back of the eye (retinal detachment). Early symptoms include flashes of light and persistent floating spots in the field of vision (“floaters”: see description above in section on vitreous detachment). As the retina peels off farther, a person loses vision painlessly, as if a curtain (“of darkness”) was descending. Retinal detachment is a serious condition and requires emergency repair.

Optic Neuritis

Optic neuritis is inflammation of the optic nerve, which carries signals from the eye to the brain in the process of vision. It causes blurred vision of gradual onset, pain with eye movement, and an aching sensation in the affected eye. Commonly associated with multiple sclerosis, it can also be caused by infections (e.g., Lyme disease), cancer, and autoimmune syndromes. The treatment is high-dose steroids and other agents administered under the care of an ophthalmologist. In any circumstance when vision becomes impaired without an obvious cause that can be effectively treated or temporized in the wilderness, get the victim to an eye doctor as soon as possible.

Glaucoma

Glaucoma is a condition in which the pressure of the fluid within the eye is elevated. If this happens suddenly, the pressure can injure the nerves within the eye that record vision; blindness can result. Symptoms of an acute attack of glaucoma include severe pain, blurred vision or “halos” around lights, clouding of the cornea, intense reddening of the white of the eye, a dilated pupil that doesn’t react to light,

nausea, vomiting, and headache. The victim of acute glaucoma is truly miserable. If an attack occurs, the victim should be kept in a sitting or standing position and rushed to an ophthalmologist. If the victim is carrying medication(s), instill a drop of pilocarpine or carbachol and (depending on which medications are carried by the victim) a drop of timolol (or betaxolol, carteolol, levobunolol, or metipronol), latanoprost (or travoprost, unoprostone, or bimatoprost), brimonidine (or apraclonidine), and/or dorzolamide (or brinzolamide) in the affected eye. If you are distant from care, and acetazolamide (Diamox) is available and there are no contraindications to its use (see page 336), it may be administered in a dose of 125 mg, 250 mg, or 500 mg sustained release by mouth twice a day.

Injured Eyelid

If the eyelid is injured, wash the eye carefully, apply bacitracin or mupirocin ointment, and then patch the eye closed (see page 181). If the eye cannot be covered with eyelid, apply a thick layer of antiseptic ointment to the eyelid and exposed eyeball and patch the eye. Seek immediate medical attention.

Sty

A sty is a small abscess (see page 241) that develops in one of the glands at the base of an eyelash. The infection causes the eyelid to swell, redden, and become painful. The victim may notice increased tear production and the sensation of a foreign body in the eye. Usually, the sty comes to a head on the outside of the lid, but occasionally it will come to a head inside. If a sty begins to develop, the victim should hold warm, moist compresses to his eyelid for 30 minutes four times a day to soften the abscess. It will either disappear or enlarge and come to a head. *Never squeeze an abscess on the face.* If the sty enlarges, comes to a head, and is extremely painful or interferes with vision, but will not open spontaneously, it can be carefully lanced with a sharp blade or needle to drain the pus. A physician should perform this procedure, unless the victim is more than 48 hours from medical attention and the infection has worsened to the extent that there is progressive swelling of the eyelid that impedes vision, or of the cheek or forehead. In this event, also administer dicloxacillin, erythromycin, or cephalexin. After the sty is incised, the pus can be expressed gently by pressing on opposite lateral sides with two cotton-tipped applicators.

Eyelid Infection and Periorbital Cellulitis

If there is a discharge and pain, with or without redness, from an eyelid on the side nearest the nose, this may be an infection in the tear duct. Apply warm compresses and administer amoxicillin-clavulanate, moxifloxacin, levofloxacin, ciprofloxacin, or cephalexin.

Redness and swelling of the eyelid and “soft” tissues around the eye (eyebrow, upper cheek) caused by infection is known as periorbital (around the orbit, or eye) cellulitis. This is extremely serious and must be treated aggressively, because the infection can spread to create an abscess in the brain. Treatment consists of administration of an antibiotic (moxifloxacin, levofloxacin, ciprofloxacin, cephalexin, clindamycin, amoxicillin-clavulanate, dicloxacillin, or erythromycin) and immediate evacuation to a hospital. To differentiate periorbital cellulitis from the swollen eyelids associated with an allergic reaction, note that with cellulitis, the onset will have been more gradual (typically associated with a less severe eye infection, such as conjunctivitis, or a local infection such as a sty or pimple), the affliction is only on one side, there are fever and chills, the soft tissues are painful, there is headache, and there is often a purulent (with pus) discharge from the eye. With an allergy, the eye is more “puffy,” the onset is sudden, the eye is itchy and watering, there is no purulent discharge, and there are associated signs and symptoms of allergy (skin rash, generalized itching, swollen lips, etc.) (see page 66).

Orbital cellulitis involves a deep infection around the eye, and presents as a swollen, red eye with significant pain on eye motion, decreased vision, and bulging of the eyeball in its socket. Victims of periorbital cellulitis have normal vision and painless motion of the eye. Orbital cellulitis is an emergency, so the victim should be started on the antibiotics listed previously and immediately evacuated to hospital medical care.

Pterygium

A pterygium is a noncancerous degeneration of the conjunctiva that occurs in persons who spend large amounts of time outdoors, particularly with exposure to ultraviolet light. It appears as a yellow, raised, “fleshy” knob of tissue that appears to begin in the nasal corner of the eye, and extends from there over the white part. It occasionally encroaches on the nasal margin of the cornea. It rarely grows further or requires treatment, because vision is usually not affected.

NOSE

Nosebleed

Nosebleed is classified as anterior or posterior, depending on where it originates within the nose. Generally, anterior nosebleed is less serious, because the victim will usually drain blood outward through the nostrils. Posterior nosebleed is more difficult to control, and the victim often drains blood back into the throat, with coughing and potential choking. Anterior nosebleed is more common and can usually be managed outside of the hospital. *If you suspect a posterior nosebleed* (bleeding from the nose accompanied by brisk bleeding into the throat, so

that a lot of blood is continually swallowed, particularly after the anterior bleeding has been controlled), *immediately evacuate the victim to a hospital*.

The most frequent cause of a nosebleed is a small bleeding blood vessel or cut on the inner mucosal surface of a nostril. This is more common at high altitudes and in cold weather, because the drying effect causes the skin to become irritated and crack. One way to prevent nosebleeds is to keep the inside of the nose lubricated with an ointment such as mupirocin or bacitracin, or to spray regularly with saline solution (such as Ocean saline mist or drops with 0.65% sodium chloride). It is possible that nosebleeds are more common in persons whose blood pressure has risen out of control. People on prescription anticoagulant drugs are prone to nosebleeds.

To control an anterior nosebleed, attempt simple maneuvers first. Have the victim blow his nose to remove all clots. Keep him upright (sitting leaning forward) and calm, and firmly press both nostrils closed against the nasal septum (middle cartilage). Hold this position for 15 minutes without release; letting go before this time will only restart the bleeding, because it takes the small blood vessels and scratched surface a while to stop oozing. After 15 minutes, let go and see if the bleeding has stopped. If not, gently but firmly pack both nostrils with a gauze or cotton roll moistened with phenylephrine 0.25% (Neo-Synephrine ¼%) and repeat the pinching maneuver for 20 minutes. Generally, this does the trick; if it doesn't, repeat the packing without the phenylephrine. After the bleeding has stopped, leave the packing in place for 2 hours and then gently remove it. Cold compresses applied to the bridge of the nose or a roll of gauze or cotton placed beneath the upper lip are of limited help when dealing with a brisk nosebleed. Packing with absorbable gelatin foam (Gelfoam) or oxidized cellulose (Surgicel) may be helpful. Another hemostatic packing gauze is QuikClot Nose-Bleed gauze (Z-Medica Corporation). A useful device for packing the nose to stop a nosebleed is the Rhino Rocket (Shippert Medical Technologies), which is a compressed medical-grade foam sponge with applicator. The foam is guided into place, where it swells on contact with moisture (blood) to 8 to 10 times its compressed size. A string is attached to the sponge so that it can be easily removed. Weimert Epistaxis (nosebleed) Packing uses a similar approach. The rapid RHINO nasal pack with Gel Knit (ArthroCare Corporation) uses a hemostatic (stops bleeding) carboxymethylcellulose fabric over an inflatable balloon to apply compression within the nose. In one study, this device was felt to be less painful to insert and easier to remove than the Rhino Rocket. Merocel is a polyvinyl alcohol nasal tampon that is inserted into the nose, whereupon exposure to a topical vasoconstrictor (e.g., phenylephrine 0.25%) and saline causes it to expand and create pressure over the bleeding point. NasalCease (Catalina Healthcare) is a bundle of fine fibers made from brown seaweed (active ingredient calcium alginate) extract that can be inserted into the nose to aid clotting.

If the nose is packed, administer an antistaphylococcal antiseptic (such as dicloxacillin or trimethoprim-sulfamethoxazole) for the duration of the packing. The nasal packing should be kept moist with sterile saline or oxymetazoline (Afrin) spray.

Broken Nose

A fractured nose may or may not be deformed. If the nose is obviously depressed or pushed to one side, and the victim is having difficulty breathing through his mouth, the nose can be relocated, but this is usually quite painful. Grasp the bridge of the nose firmly and crunch it upward and back over to the midline. In the wilderness, it can be difficult to improvise an external splint. A malleable soft-aluminum nasal splint with adhesive ventilating foam is available as The Denver Splint (Shippert Medical Technologies). Treat any nosebleed as previously discussed. *The only reason to relocate the injury is to improve breathing if mouth breathing is inadequate.* The nasal bones won't begin to set solidly for 5 to 7 days; cosmetic manipulation can easily be performed after such a delay. If the skin is cut deeply over a broken nose, start the victim on an antibiotic (penicillin, cephalixin, or erythromycin).

Another risk from a broken nose is the formation of a blood clot under the skin that lies over the nasal septum (cartilage) between the nostrils. If such a clot is not promptly drained, its resolution can cause collapse of the cartilage, infection, or erosion through the septum, leaving a hole through the septum. Anyone who has suffered a broken nose needs to be examined by a physician within 3 to 5 days of the injury, to avoid erosion of the nasal septum by a blood clot.

Foreign Body in the Nose

A small child will occasionally stuff a foreign object, such as a pebble or bead, into a nostril, where it will become stuck. Signs and symptoms include pain, a foul-smelling drainage, and sometimes fever. This can be a tough problem away from the hospital, because once the sensitive skin inside the nostril becomes irritated, it swells and traps the foreign object within a matrix of mucus, and sometimes blood or pus. If the object can't be easily seen and extracted without forcing it farther into the nostril or torturing the child, seek a physician's assistance. If you are carrying a flashlight and a small nasal speculum (a device for gently widening the nostril to facilitate access to the inside of the nose—Disposable Nasal Speculum, Bionix), you can attempt to look up the nose, but most small children will be extremely uncooperative, because this is pretty uncomfortable for them. One way to remove a nasal foreign body is to put a small dab of cyanoacrylate glue on the tip of a small stick (such as the rod portion of a cotton-tipped swab), and then hold the stick against the object until it is stuck, so that the stick can be used to pull out the object. If the object is metallic, try using a magnet. If fever is present, start the child on dicloxacillin or erythromycin.

Sinusitis

The sinuses are spaces filled with air and lined with mucus-producing tissues found in the front of the skull and in the bones of the face (Figure 115). Sinusitis is a blockage and infection/inflammation of the lining of the sinuses, usually caused

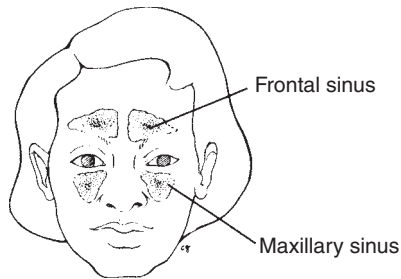


Figure 115. Location of the sinuses.

by bacteria, and characterized by nasal congestion, headache, fever, decreased ability to smell, and tenderness in and over the involved sinus, with or without foul yellow or green discharge from the nose. Occasionally, the pain radiates to the eyes, bridge of the nose, and upper teeth. It is often made worse by bending forward. A person with sinusitis can become quite ill and suffer from excruciating headache, nausea, vomiting, and chills. Treatment involves the administration of an antibiotic (first choice is amoxicillin-clavulanate, amoxicillin, azithromycin, or telithromycin; other choices include moxifloxacin, levofloxacin, clarithromycin, doxycycline, ciprofloxacin, trovafloxacin, levofloxacin, moxifloxacin, cefuroxime axetil, cefpodoxime, cefprozil, cefdinir, loracarbef, or erythromycin) and decongestants (oral pseudoephedrine and a nasal spray: phenylephrine 0.25% [Neo-Synephrine ¼%] or oxymetazoline 0.05% [Afrin]), as well as warm packs over the affected area(s). Don't use a topical decongestant for more than 3 or 4 consecutive days, to avoid "rebound" swelling of the inside of the nasal passages from chemical irritation and sensitization to the drug. Antihistamine drugs should not be routinely used, because they may dry out nasal and sinus secretions. A person suffering from sinusitis should avoid rapid changes in ambient external pressure (such as scuba diving or air travel in unpressurized aircraft).

THROAT

Sore Throat and Tonsillitis

Sore throat (pharyngitis) is a common complication of viral infections (the common cold, infectious mononucleosis), breathing dry air ("altitude throat"), or primary bacterial throat infection ("strep throat"). Symptoms of an infection include pain with swallowing, fever, swollen lymph nodes ("swollen glands") in the anterior neck, red throat, swollen tonsils, pus over the tonsils and throat (Figure 116), headache, fever, abdominal pain, and nausea and vomiting.

Because the symptoms of a viral throat and tonsil infection and a bacterial strep (group A beta-hemolytic streptococcus [GABHS]) throat are frequently identical, it is hard to make the differentiation without a throat-swab "rapid strep test" or bacterial culture. Below age 3 years, a child rarely has a strep throat; in young adults, the presence of strep throat in the presence of classic symptoms

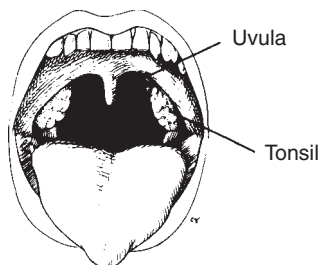


Figure 116. Inflamed tonsils.

(fever, pus, and swollen tonsils and lymph glands in the neck) is roughly 50%. However, because the potential complications (kidney or heart disease) of an untreated strep throat in a young person outweigh the complications of antibiotic use, it is advisable to treat with penicillin (or amoxicillin), cefadroxil, or erythromycin for a full 10-day course, or with azithromycin or clarithromycin for 5 days. If none of these drugs is available, clindamycin or cephalexin can be used. Even if the victim improves after 2 to 3 days, the antibiotic should be taken for the full course.

Adjuncts to care include saltwater gargles ($\frac{1}{2}$ tsp, or 2.5 mL, of table salt in 1 cup, or 237 mL, of warm water), throat lozenges, warm fluids (to moisten and soothe the throat), and aspirin or acetaminophen to control fever. To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.

If a person develops an acute sore throat that rapidly becomes extremely uncomfortable (severe pain, difficulty swallowing), a single dose of dexamethasone or its equivalent (see page 340) may be given along with an antibiotic, assuming the victim can swallow the medications. This may help decrease inflammation, but should not be given routinely for a “nontoxic,” or run-of-the-mill, sore throat. *If someone with a sore throat has a high fever associated with difficult or noisy breathing, altered (e.g. hoarse) or muffled voice (“like talking with a potato in his mouth”), drooling, stiff neck, or any visible swelling (bulging) in the back of the throat, he should be made as comfortable as possible and transported immediately to a hospital.* Such a condition may indicate an abscess (see page 241) in the back of the throat or next to a tonsil, infection and inflammation of the epiglottis (epiglottitis), or massively swollen tonsils. Any of these may rapidly obstruct the airway.

If a person develops tender swelling under the tongue and/or under the chin, particularly associated with swollen lymph glands in the neck, fever, difficulty swallowing, and foul breath, this may indicate an infection in the floor of the mouth. Treat the victim with an antibiotic as for a strep throat and seek immediate physician consultation.

A sore throat can be caused by overgrowth of the fungus *Candida albicans*, which leads to a condition known as “thrush.” This occurs most commonly in persons who are immunosuppressed, have recently taken broad-spectrum antibiotics, use inhaled or oral steroids, wear dentures or orthodontic appliances,

have diabetes, or are elders. Symptoms include burning in the mouth and throat, white patches on the palate and in the mouth and throat, painful swallowing, heartburn, drooling, and loss of appetite. If thrush is suspected, it can be treated with nystatin (Mycostatin) oral suspension, swished and swallowed four times a day for 2 weeks, or with nystatin oral lozenges 4 to 5 times daily for 2 weeks.

Infectious Mononucleosis

Mononucleosis (“mono”) is a viral disease characterized by low-grade (less than 101°F, or 38.3°C) fever, sore throat, swollen lymph glands (mostly in the neck, but occasionally in the armpits or in the groin), headache, fatigue, and, occasionally, skin rash, dark urine, muscle aching, and an enlarged spleen. Treatment consists of increased rest (it sometimes requires weeks for a normal energy level to return) and elimination of any physical activity that requires heavy exertion or risks abdominal injury (and thus rupture of the spleen). The diagnosis is confirmed by a blood test; until that can be performed, the victim should be treated for a possible strep throat (see page 195). Because infectious mononucleosis can be spread via saliva, infected people should avoid sharing eating utensils and towels.

Common Cold

See page 202.

MOUTH

Fever Blisters (Cold Sores)

Crops of blisters on the face, mouth, and lips that break out in times of stress (viral illness, emotional crisis, intense sun exposure) are often caused by reactivated herpes simplex virus (usually HSV-1). The blisters often weep and may become infected. Unfortunately, there is little to do for these when they first appear except keep them clean and dry. If the skin cracks and becomes painful, the blisters may be lubricated with bacitracin or mupirocin ointment. Anesthetic ointment can be used if it is helpful. Further sun exposure should be prevented with an adequate lip sunscreen (see page 228) of sun protection factor (SPF) 20 or greater.

Untreated, the lesions will disappear spontaneously in 10 to 15 days. Penciclovir 1% cream applied to the skin or lips every 2 hours while awake for 4 days may be prescribed to hasten resolution. Alternatively, acyclovir (Zovirax) ointment applied thinly five times a day for a week can hasten resolution of the blisters. Another treatment is acyclovir 200 mg by mouth five times a day, or 400 mg three times a day, for 5 days.

All herpes viruses are contagious. During times of visible blisters, eating and drinking utensils should not be shared. To maximize prevention, use a high-SPF sunscreen and consider taking acyclovir (Zovirax) (400 mg twice daily by mouth) the day before and during intense ultraviolet light exposure.

Canker (Mouth) Sores (Aphthous Ulcers or Stomatitis)

These painful white patches with reddened (inflamed) edges form inside the mouth and may be associated with viral infections or an immune response to an infection or disease. Usually they are a chronic problem. Untreated, they last for 10 to 14 days. They may be treated with a topical application of anesthetic lidocaine ointment 2.5% for a minute or two before eating, to kill the pain temporarily. An alternative is to swish and spit the antacid Maalox. Another useful topical anesthetic is 20% benzocaine (Hurricane, Beutlich Pharmaceuticals), which can be conveniently applied from a prepackaged dry handle swab. Lidocaine viscous gel 5% may be applied to ulcers 4 times daily for 2 weeks or until ulcers heal. One recommendation is to apply a pinch of powdered alum (as in a styptic pencil) to initiate healing. Another is to apply the topical bioadhesive carmellose (Orabase) 4 times daily for 2 weeks or until ulcers heal. To hasten resolution, a physician might prescribe a mixture of fluocinonide 0.05% cream (Metosyn) and Orabase to be laid over the ulcer four times per day, or triamcinolone dental paste 1% (Adcortyl, or Kenalog in Orabase) to be administered similarly. Five percent amlexanox paste (Aphthasol) is an antiinflammatory treatment that is applied to ulcers 4 times a day for 2 weeks or until ulcers heal. The inside of the mouth should be rinsed thoroughly after eating to prevent food from becoming trapped in the sores. Antimicrobial mouthwashes, such as those containing chlorhexidine gluconate (0.12% or 0.2%), used three times daily may help prevent the onset of new sores. Any new sore in the mouth of an elderly person or frequent user of tobacco should be seen by a physician, who must consider a precancerous lesion or oral cancer.

Black Tongue

Black “hairy” discoloration of the tongue may be caused by excessive growth of the papillae of the tongue. It may be associated with topical or systemic antibiotics, poor mouth and dental hygiene, smoking, drinking alcohol, or even certain mouthwashes. Usually, the only symptom is the discoloration, but some patients suffer nausea, bad breath, or altered taste of food. Treatment consists of brushing the tongue with a soft brush. Black hairy tongue may be due to the presence of a yeast (e.g., *Candida albicans*) infection and/or the use of certain medications, such as bismuth (found in Pepto-Bismol) or doxycycline. If the discoloration does not resolve spontaneously, it may be treated with clotrimazole (10 mg troche dissolved in the mouth 5 times a day

for 14 days) or with a 3-day treatment of fluconazole (150 mg by mouth once a day).

Toothaches and Tooth Infections

Toothaches occur in teeth that are decayed or have lost fillings. In this manner, the central pulp, which carries nerves and blood vessels, becomes inflamed (pulpitis). Symptoms of tooth inflammation include pain in the tooth and jaw that occasionally travels into the neck and ear, pain on contact with cold or hot liquids, and headache. Sometimes it is difficult to localize the problem to a specific tooth, since it may not be sensitive when it is tapped. To identify the culprit tooth, apply an ice cube sequentially to each tooth until you elicit a painful reaction. Pain medication appropriate for the degree of suffering should be administered. Have the victim keep his head elevated.

If it hurts to bite down on a tooth, but nothing is obvious on inspection of it, there may be inflammation of the supporting structures. In this case, the victim can point to the affected tooth, or feel pain when you tap on a particular tooth. Treatment is a soft diet, pain medication, and something like a strip of leather to bite down on positioned on the nonpainful (opposite) side, to create a space and prevent pressure on the affected tooth.

If an abscess (infection) (see page 241) develops in the root of the tooth or in the gum, there may be associated fever; swelling of the gum, jaw, or palate; and swollen lymph glands under the jaw and in the neck. If the abscess extends, the cheek and side of the face may swell. The victim should be started on penicillin, metronidazole, cephalexin, or erythromycin, and given appropriate pain medication. If there is a soft, pointing abscess in the gum adjacent to a tooth and the victim is suffering, the abscess can be punctured with a scalpel or knife and drained (Figure 117). Hold snow or ice against the gum to provide some anesthesia before the incision. A gauze or cotton wick should be placed into the abscess cavity for a day or two (see page 243). After this procedure, the area should be rinsed with salt water after each meal, at least four times a day.

To temporarily treat a cavity (decay) or site of a lost filling, dry the affected tooth carefully with cotton. Next, apply a cotton pad moistened with oil of cloves (eugenol) to the tooth cavity. In a pinch, you can use vanilla extract. Take care to keep eugenol off the gums, lips, and inside surfaces of the cheeks. Alternatively, topical benzocaine (Anbesol) can be applied to the gums. The patient needs to be taken to a dentist to have the tooth repaired or removed.

Another remedy for a cavity caused by decay or a lost filling is to fill the cavity with temporary filling material from a dental kit. Such materials include Cavit, which requires no mixing. It is applied directly to the tooth, using a wetted toothpick or cotton-tipped applicator as a packing and shaping instrument. Intermediate Restorative Material (IRM) is prepared by adding a few drops of clove oil to powdered zinc oxide to make as dry a "dough" as possible. Zinc oxide-eugenol combination cements are advantageous in that they have an

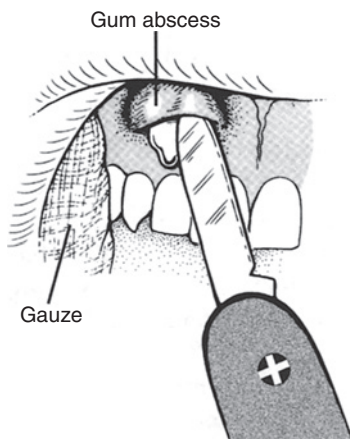


Figure 117. Incision and drainage of a gum abscess.

anesthetic effect and can be mixed to different consistencies, depending on whether they are to be used as filling material or adhesives. However, the liquid can leak from its container, and the cement is sticky and more difficult to work with than Cavit.

Such fillings set after exposure to saliva and usually have to be replaced every few days. Another improvised filling is softened candle wax mixed with a few strands of cotton fiber, applied over a drop or two of eugenol.

If the gum line is inflamed or appears to be infected adjacent to a tooth, you can try to “break up” the infection by flossing vigorously or running a toothpick (probe) down into the space between the tooth and gum line. Administer an antibiotic, such as penicillin or metronidazole.

Pericoronitis is an infection of the gum flap that overlies a tooth that has only partially advanced (“erupted”) into the mouth. This is most common with a lower third molar and usually indicates an infection with *Streptococcus* bacteria. The treatment is to scrape and clean underneath and around the flap, initiate warm saltwater rinses every 2 hours, and begin the victim on dicloxacillin, cephalexin, or erythromycin.

Broken, Displaced, or Lost Tooth

If a tooth is cracked (with the root still present and in place), there is little for the victim to do other than keep his mouth clean and avoid contact with extremes of temperature. If air, saliva, the tongue, or temperature change coming into contact with an exposed nerve causes intolerable pain, a temporary cap (shield) can be created by mixing melted paraffin (candle wax) with a few strands of cotton. When the mixture begins to harden but can still be easily molded, press a wad onto the tooth, using the teeth on either side as

anchors. A cap can also be fashioned from Cavit or IRM (see the discussion above).

If a tooth is broken or a crown falls off, apply a little eugenol to the tooth for immediate pain control. For a displaced crown, press it back onto the tooth and see if the crown will hold without cement. If not, apply a dab of Cavit and use it as a fastener, scraping away the excess. If all else fails, cover the tooth with paraffin or dental wax.

If a tooth is shifted out of its normal position, but is still embedded in the gum, it may need to be repositioned. If the tooth appears to be longer or off to one side, use a gloved hand, firmly grasp the tooth, and move it into proper alignment. If the tooth has been pushed into the gum and appears to be too short, do not move the tooth.

If a tooth is knocked cleanly out of the socket, it can sometimes be replaced successfully if the victim can reach a dentist within the first hour. After 2 hours, there is little hope for salvage of that particular tooth. The best treatment for a tooth that has been out of the socket for 15 minutes or less is to gently rinse it clean (do not scrub the root of the tooth) and reinsert it with firm pressure into the socket to the level of the adjacent tooth. Try to splint the tooth in place with a paraffin bridge or a cap to the adjacent tooth. A better material for this purpose is Express Putty, which hardens within 4 minutes after equal amounts of the putty base and catalyst are mixed.

The best storage solution for a tooth that will be carried to a dentist is pH (acid-base) balanced (Hank's balanced salt solution) and accompanied by a cushion to prevent injury to the microscopic ligament cells that hold the tooth in place and must reattach for the tooth to "take." The Save-A-Tooth or EMT Toothsaver storage device is recommended.

Alternatively, the tooth can be placed in a container and covered with a small amount of cool, pasteurized whole milk (not yogurt, low-fat milk, or powdered milk) for transport. Do not carry the tooth on a dry cloth or paper. Do not soak the tooth in tap water. A tooth can also be rinsed and carried by the victim in the space between his lower lip and lower gum (taking care not to swallow the tooth), although saliva is not particularly good for the periodontal ligament. *Do not place a tooth back into the socket unless an antibiotic (penicillin 500 mg four times a day for 2 weeks) can be administered to avoid an infection, and tetanus toxoid given if necessary.*

If the socket of a broken or lost tooth continues to bleed, apply direct pressure by having the victim bite on a gauze pack for 30 minutes. If there is a large blood clot, remove it, and then apply pressure. Keep the head elevated. Avoid rinsing, spitting, tooth brushing, and tobacco use for 24 hours. Gentle rinses with warm saltwater can be started after that time period. If the bleeding does not stop after several hours, biting on a dry tea bag (tannic acid) may help. "Dry socket" may occur 2 to 4 days after a tooth is lost. This is characterized by pain, foul odor, and a bad taste. Inspection of the tooth socket may show exposed bone. Treatment is gentle saltwater rinses followed by packing with a strip of eugenol-soaked gauze. The pack should be changed every 1 to 2 days until the symptoms are

relieved, which may take up to 10 days. During this period, do not ingest alcohol or carbonated beverages.

Temporomandibular Joint (TMJ) Syndrome

The temporomandibular joint—where the jaw hinges into the face—can become tender if the jaw is struck, from forceful chewing or yawning, or from grinding the teeth at night. If this joint becomes irritated, the pain can be extremely distracting. Therapy consists of a nonsteroidal antiinflammatory drug such as ibuprofen, warm packs, and avoiding foods (such as beef jerky) that are difficult to chew. Don't chew gum or open the mouth excessively wide.

Mouth Ulcer (Canker Sore)

See page 198.



UPPER RESPIRATORY DISORDERS

COMMON COLD

Most “colds” are upper respiratory tract infections caused by one of a host (at least 200) of viruses. It is not true that exposure to a cold climate (“catching a chill”) causes a cold. Symptoms include runny nose, cough, sore throat, headache, muscle aches, fever, fatigue, weakness, and occasional nausea with vomiting and/or diarrhea. Unfortunately, there is no cure for the common cold. The best medicine is rest, increased fluid intake to prevent dehydration and loosen secretions, and acetaminophen or aspirin for fever. *To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.*

Keep the victim warm and dry. For persons ages 6 years and older, treat nasal congestion with an oral decongestant and nasal spray (use the latter for 3 days

maximum). Be aware that an oral decongestant can make a child hyperactive. For an infant, use saline nose drops ($\frac{1}{4}$ tsp, or 1.3 mL, of table salt in 1 cup, or 237 mL, of water) in a dose of two to three drops in each nostril a few times a day; the child will sneeze, or the drops can drain via gravity or be sucked out with a “baby bulb” syringe.

A person who breathes steam (which has not been proven to improve a common cold) must be careful to avoid burns. There is no scientific evidence to support the use of chest rubs or megavitamins (specifically, vitamin C) in the prevention or amelioration of viral illnesses. Probably the most important factor in rehabilitation is adequate rest.

Do not attempt to “sweat out” a cold with vigorous exercise. Such harmful behavior causes worsened fever, debilitation, and dehydration. It is a method guaranteed to convert a common cold into pneumonia. A person with a cold should see a doctor if he is ill for more than 3 weeks, his temperature elevation becomes extreme (see page 167), he develops a cough productive of yellow-green or darkened phlegm (see pages 48 and 205), or he develops chest pain associated with breathing, shaking chills, a severe earache, or a headache with a stiff neck (see page 174). Since colds are spread by contact, take particular care to wash your hands after contact with an infected person.

The most common complication of a cold in a child is a middle ear infection. If a child with a runny nose and cough begins to pull at his ear(s) or if a fever returns near the end of the course of a cold, consider treating the child for otitis media (see page 175). Pneumonia can also be a complication (see page 48). It should be suspected in a child who appears short of breath (respiratory rate above 30 per minute in a child, or 40 per minute in an infant).

A cold can be differentiated from seasonal allergies on the basis of the following: cold—fever, chills, yellowish or green nasal discharge, sore throat, diarrhea, muscle aches; allergies—clear nasal discharge, repetitive sneezing, watery and itchy eyes.

Someone who has a chronic (lasts longer than 3 weeks) cough not clearly associated with a cold or other viral infection of the respiratory tract, who is coughing up blood, or who has another known problem such as pneumonia or lung cancer should seek the attention of a physician. The most common causes of a chronic cough are cigarette smoking, postnasal drip (often stimulated by seasonal allergies), unsuspected asthma, chronic sinus infection, or acid reflux from the stomach into the esophagus. In addition, those who take a certain category of medicine (angiotensin-converting enzyme [ACE] inhibitors) to treat high blood pressure may develop a cough; this usually disappears a few days after the medicine is discontinued.

A U.S. FOOD AND DRUG ADMINISTRATION ADVISORY PANEL IN 2007 RECOMMENDED THAT THERE IS NO EVIDENCE THAT OVER-THE-COUNTER COLD AND COUGH MEDICINES WORK IN CHILDREN AND THAT THE PRODUCTS SHOULD NOT BE GIVEN TO CHILDREN YOUNGER THAN 6 YEARS OF AGE.

INFLUENZA

The influenza viruses are responsible for seasonal epidemics of the flu, a predominantly respiratory disease. In temperate climates, influenza is a cold weather disease. The illness is recognized by sudden high fever, sore throat, cough, headache, muscle aches, weakness, and occasional (more common in children) nausea with vomiting and/or diarrhea. “Stomach flu” is a misnomer, because it is not caused by influenza virus, but rather, by other viruses and bacteria. Influenza is distinguished from a common cold by its intensity, particularly of the headache and muscle aches. The virus is transmitted from person to person via virus-laden large droplets (greater than 5 microns in diameter) generated when infected persons cough or sneeze.

Elderly or infirm individuals are at greatest risk for becoming severely debilitated or developing complications, such as pneumonia. General therapy is the same as that for a cold: rest, adequate nutrition, increased fluid intake, and medicine for fever. Vaccines are prepared each year that are somewhat effective in the prevention of types A and B influenza (see page 456). Oseltamivir phosphate (Tamiflu) is a drug that is used for treatment of influenza types A and B in adults who have been ill for no more than 2 days. It is given in an adult oral dose of 75 mg twice daily for 5 days. The pediatric dose is based on age and weight. For a child age 1 to 12 years: weight less than 15 kg, 30 mg twice daily for 5 days; 15 to 23 kg, 45 mg twice daily for 5 days; 23 to 40 kg, 60 mg twice daily for 5 days; weight greater than 40 kg or age greater than 12 years, 75 mg twice daily for 5 days. An alternative is zanamivir (Relenza) 10 mg inhaled twice a day for 5 days for all ages.

During an epidemic, victims may benefit from the administration of the oral drug rimantadine 200 mg by mouth daily for 5 to 7 days in adults, and 5 mg/kg of body weight per day (up to 150 mg) for 5 to 7 days in children. An alternative is amantadine in a dose of 100 mg twice daily for 5 days in adults, or 2.2 mg/kg of body weight (up to 75 mg) twice daily for 5 days in children. These are available by prescription for the prevention and treatment of type A influenza (they are ineffective against type B). They are associated with several toxic effects and also contribute to emergence of resistance against them by the influenza virus type A.

Avian influenza A (H₅N₁, which exists in at least 8 subgroups, or “clades”) may be resistant to the adamantane drugs (rimantadine and amantadine), so would be treated with zanamivir or oseltamivir, the former in a dose of 75 mg and the latter in a dose of 150 mg by mouth twice a day for 10 days. This form of influenza is carried and spread by birds, notably poultry and perhaps wild birds. It has been found in other species, such as cats, tigers, leopards, pigs, ferrets, rabbits, rats, and emus, from where it might more rapidly mutate to a form more infectious to humans. Avian flu has a very aggressive profile, with a high (up to 60%) overall mortality rate in human victims. Infected humans show “typical” flu symptoms, followed rapidly by respiratory and multiorgan failure. There is little evidence for mild or asymptomatic human infections. With regard to protective masks, an N95 respirator mask is supposed to have at least a

95% filtration capability at filtering a 0.3 micron droplet, which carries the virus, but not the virus particles individually.

BRONCHITIS

Bronchitis is an inflammation of the air passages (bronchi), characterized by cough that persists for more than 5 days, production of sputum (yellow or green phlegm, or “secretions”), fever, hoarseness, muscle aches, fatigue, and sometimes wheezing. Pneumonia is much more intense than bronchitis, and involves severe progressive pulmonary deterioration; bronchitis is a less debilitating condition. Cigarette smokers are prone to recurrent bouts of bronchitis, because they suffer from scarred lungs and continually paralyze the defense mechanisms of the nose, throat, and lungs with cigarette smoke. Viruses and bacteria may cause bronchitis.

Treatment is controversial, since in the absence of a documented infection, no particular therapy has been shown to shorten the duration of bronchitis. If a persistent (more than 10 to 14 days) infection is suspected, therapy may include administration of an oral antibiotic (first choice azithromycin, levofloxacin, or amoxicillin-clavulanate; others include moxifloxacin, amoxicillin, trimethoprim-sulfamethoxazole, doxycycline, cefixime, cefpodixime, cefprozil, or erythromycin). With or without antibiotics, copious fluid intake, inhalation of humidified warm air (taking care to avoid steam burns) in order to loosen secretions and ease coughing, a drug to loosen secretions (e.g., guaifenesin [Mucinex] 600 mg by mouth every 12 hours), and acetaminophen or aspirin (the latter not for children under age 17 years) for fever may diminish symptoms. It is best to allow the victim to cough up secretions; however, if coughing fits become intolerable, a cough medicine (see page 503) may be used. Dextromethorphan is more effective than guaifenesin, which does not control cough. A 7-day course of inhaled or oral corticosteroids may help. If wheezing and shortness of breath are problematic, an inhaled bronchodilator, such as albuterol, may be used. If pneumonia is suspected (see page 48), treat appropriately and seek immediate medical attention.

HAY FEVER

Hay fever (“rose fever,” “catarrh”) is an allergic reaction, often seasonal (hence the term “seasonal allergies”) to dust, animal dander, plant (usually ragweed, sage, trees, and grasses) pollens, or other compounds found in the air. The victim suffers from red, itchy, and watery (from excessive tearing) eyes; swelling of the eyelids; white, ropey mucus discharge from the eyes; a runny nose with large amounts of clear mucus (allergic rhinitis); sneezing; and general misery. In a severe case, a victim may suffer asthma, sinusitis, loss of smell, and fatigue. In most cases, the symptoms can be relieved by

taking an antihistamine medication—although some of these have side effects, the most troublesome of which is drowsiness. Antihistamines that cause drowsiness include triprolidine (Actifed), diphenhydramine (Benadryl), and chlorpheniramine (Chlor-Trimeton). Nonsedating antihistamines, such as fexofenadine (Allegra), loratadine (Claritin), and cetirizine (Zyrtec), cause much less or no drowsiness. A nasal decongestant (such as oxymetazoline [Afrin]) will clear out the nose, but does not halt the allergic reaction. Furthermore, a nasal decongestant should not be used for more than 5 consecutive days, to avoid “rebound” nasal congestion from drug-induced inflammation. An allergy doctor can use skin tests to evaluate a victim for desensitization injections. If allergies are debilitating and a change in environment is impossible, the victim will almost certainly benefit from a tapering dose of prednisone (see page 492). Nasal steroid sprays (such as fluticasone propionate 0.05% [Flonase], budesonide 32 mcg nasal spray [Rhinocort Aqua], or beclomethasone dipropionate [Beconase]) are a method for treating nasal irritation (blockage, runny nose, itching, and sneezing) from allergies, but usually require approximately 3 days of continual use before a beneficial effect is noted. Cromolyn sodium nasal spray (Nasal crom), as recommended by some allergists, is another useful adjunct. This requires administration of up to four to six doses per day, and it may be 1 to 4 weeks before any benefit is noted.

Nonsteroidal eyedrops for ocular allergy manifestations (seasonal allergic conjunctivitis) include 4% cromolyn sodium, ketorolac tromethamine 0.5% (Acular), lodoxamide 0.1% (stabilizes the cells that release histamine), and levocabastine hydrochloride 0.05% (histamine antagonist). While each of these is effective, it remains to be proven if any is more effective than cold soaks, artificial tears, or over-the-counter topical antihistamine (antazoline or pheniramine, combined with the blood vessel–constricting drug naphazoline hydrochloride) eyedrops. Eye symptoms usually respond to oral medications used to treat systemic allergies.

PLEURITIS

The lining of the lung, or pleura, is two layers of tissue separated by a thin film of lubricating fluid, which allows the lung to expand with a gliding motion when the chest wall moves outward during inhalation. When the pleura is irritated by an infection, most often caused by a virus, the inflammation may allow fluid to accumulate in this space and cause pain with breathing, localized to the area of irritation. The pain is sharp and worsened by a cough or deep breath. The treatment for viral pleuritis is rest and aspirin. Encourage the victim to breathe deeply. If he is weak or has a high fever, suspect deterioration into pneumonia (see page 48).



DISORDERS OF THE GASTROINTESTINAL TRACT

DIARRHEA

Although diarrhea is included here in the “minor problems” section, severe diarrhea can be devastating. Diarrhea can be due to a number of causes, which include bacterial infection, viral infection, protozoal infection, food poisoning from toxin(s), unusual parasites (such as *Cyclospora cayetanensis*, which can contaminate fresh berries, or *Cryptosporidium* species, which are waterborne), inflammatory bowel disease, allergies, and anxiety. It is not always easy to determine the cause of loose bowel movements, but there is a general approach to therapy that ordinarily suffices until a precise diagnosis can be made.

In all cases of diarrhea, a common discomfort is the irritated anus (particularly one that has been wiped with leaves or newspaper). Every traveler should carry a roll of toilet paper, baby wipes, and 1% hydrocortisone lotion or steroid ointment for an irritated bottom. Desitin diaper cream and A&D ointment also work well.

General Therapy for Diarrhea

Diet. If nausea and vomiting do not prevent eating, adjust the diet:

1. When diarrhea is severe, stick to clear fluids such as mineral water, soda, Kool-Aid, or broth. Electrolyte-containing sports beverages are fine. Apple and grape juices are good, but orange, tomato, pineapple, and grapefruit juices may irritate the stomach. Avoid milk products, tea, coffee, raw fruits and vegetables, and fatty foods. Do not take aspirin.
2. As soon as there is improvement (less frequent bowel movements, decreased cramping, increased appetite), begin solid foods, starting with broth, crackers, toast, gelatin, and hard-boiled eggs.
3. As the diarrhea subsides, add applesauce, mashed bananas, rice, boiled or baked potatoes, and plain pasta.
4. When stools begin to harden, add cooked lean meat, cooked vegetables, yogurt, and cottage cheese. Avoid alcohol, spicy foods, and stewed fruit.

Dehydration can be estimated as follows:

1. Mild dehydration: thirst, dry mucous membranes (mouth, eyes), dry armpits, dark urine, decreased sweating, normal pulse rate.
2. Moderate dehydration: the above plus sunken eyes, doughy skin, weakness, scant darkened urine, rapid and weak pulse rate.
3. Severe dehydration: the above plus altered mental status, elevated body temperature, no urine, no tears, no sweating, collapse, shock (see page 60).

In a baby, dehydration is manifest as dry diaper (decreased urine output), sunken eyes, sunken “soft spot” (fontanel) on the top of the head, dry tongue and mouth, rapid pulse, poor skin color (blue or pale), lethargy (“floppy baby”), and fast breathing (greater than 30 breaths per minute in a small child, or 40 per minute in an infant). For purposes of estimation, a normal pulse rate (per minute) in a newborn averages 120; at 2 years, 110; at 4 to 6 years, 100; and at 8 to 10 years, 90.

Fluid replacement. If fluid losses are significant (more than five bowel movements per day), begin to replace liquids as soon as you can.

1. *Mild diarrhea/dehydration:* Drink soda water, clear juices, broth, and electrolyte-containing sports beverages. Try to replace each diarrheal stool with 10 mL of oral rehydration salts (ORS) per 1 kg (2.2 lb) of body weight. If the child is vomiting, try to replace each episode of vomiting with 2 mL of ORS per 1 kg (2.2 lb) of body weight.
2. *Moderate diarrhea/dehydration:* Drink diluted (by half, with water) electrolyte-containing sports beverages, mineral water (bottled), or a homemade solution (1 quart or liter of disinfected water plus $\frac{1}{2}$ to 1 tsp, or 1.3 to 2.5 mL, of sodium chloride [table salt], $\frac{1}{2}$ tsp of sodium bicarbonate [baking soda], $\frac{1}{4}$ tsp, or 0.6 mL, of potassium chloride [salt substitute], and glucose [6 to 8 tsp, or 30 to 40 mL, of table sugar; or 1 to 2 tbsp, or 15 to 30 mL, of honey]). Take care not to oversweeten (exceed 2% to 2.5% glucose) the solution with sugar, because this may worsen the diarrhea; too high a sugar concentration inhibits water absorption through the gastrointestinal tract. Each quart of this “home brew” should be alternated with $\frac{1}{2}$ to 1 quart of plain disinfected water. Try to replace fluid losses at least every 2 hours.

Oral rehydration salts (ORS) that meet World Health Organization standards are available in a dry mix; use one packet per quart (liter) of water. One packet contains sodium chloride 3.5 g, potassium chloride 1.5 g, glucose 20 g, and trisodium citrate 2.9 g (or sodium bicarbonate 2.5 g). Cera Lyte 70 oral rehydration salts are based on a rice solution. One packet is mixed with a quart (liter) of water. After the solution is prepared, it should be consumed or discarded within 12 hours if kept at room temperature or 24 hours if kept refrigerated. Other ORS products available over-the-counter include Pedialyte, Enfalyte, Naturalyte, and Rehydralyte.

Try to get the victim to ingest a quart per hour until the frequency of urination begins to increase and the urine color turns light or clear. To begin, start with small (e.g., 5 mL or 1 teaspoon) amounts every 1 to 2 minutes, to avoid collection of a large amount of fluid in the stomach that might cause vomiting. A child should be given $1\frac{1}{2}$ oz (44 mL) of ORS per pound (0.45 kg) of body weight over the first 4 hours, then 1 oz (30 mL) of ORS per pound of body weight per 8-hour period until the diarrhea resolves. Another estimate of fluid replacement for children is 100 mL (approximately 3 oz) of fluid per significant loose bowel movement. For an

infant with diarrhea, decrease the amount of milk in the diet, and add more water, diluted juices, half-strength sports beverages, and ORS. Sweetened carbonated beverages (soda pop) are not good replacement fluids, because they contain too much sugar and little or no sodium and potassium. If the child is breast-fed, keep nursing (offer the breast more often). If the child is formula-fed, use ORS for 12 to 24 hours, and then try switching back to formula. If the diarrhea persists switch back to ORS for another cycle. It is important to continue to provide nourishment with food (and calories) to children with diarrhea, not fluid alone. Avoid foods high in simple sugars (including tea, juices, and soft drinks). Try complex carbohydrates (rice, wheat, potatoes, bread, cereals), yogurt, lean meat, fruits, and vegetables.

If premeasured salts are not available with which to supplement water, you can alternate glasses of the following two fluids, as recommended by the U.S. Public Health Service:

- Glass one—8 oz fruit juice with $\frac{1}{4}$ tsp (a “pinch”) table salt and $\frac{1}{2}$ tsp honey or corn syrup (237 mL juice, 1.3 mL table salt, 2.5 mL honey or corn syrup)
- Glass two—8 oz disinfected water with $\frac{1}{4}$ tsp baking soda (sodium bicarbonate) (237 mL water, 1.3 mL baking soda)

Another homemade fluid mixture is 1 tsp (5 mL) table salt and 1 cup (275 mL) rice cereal in a quart (liter) of water; this must be used within 12 hours or discarded. If only fruit juice (without supplementation) is available, remember to cut it to half strength with water. Otherwise, the sugar content will be too high and may contribute to continued diarrhea. Estimation techniques to measure powdered ingredients (such as a “pinch” of table salt) are notoriously inaccurate, and can even be dangerous if you add excessive amounts. Use a proper measuring implement whenever possible.

3. *Severe diarrhea/dehydration*: Same as moderate. After a certain point, as with cholera, intravenous hydration may be lifesaving. See a physician as soon as possible.

If nausea and vomiting are present to a degree sufficient to inhibit or prevent oral rehydration, consider administration of an antiemetic drug, such as ondansetron (Zofran: adult dose 4 mg oral dissolving tablet; pediatric dose 0.15 mg/kg body weight of the oral dissolving tablet every 8 hours).

Antimotility (decreased bowel activity) drugs. If fever, severe cramping, and bloody diarrhea are absent, it is safe to use antimotility drugs, although they should be immediately discontinued if diarrhea lasts for more than 48 hours. If diarrhea lasts longer than 3 days, if the victim has a fever greater than 101°F (38.3°C), if he cannot keep liquids down because of vomiting, if there is blood in or on the stool, if the abdomen becomes swollen, or if there is no significant pain relief after 24 hours, seek a physician immediately.

The antimotility drug of choice is loperamide (Imodium A-D). The initial adult dose is 4 mg (two 2 mg capsules, or 4 tsp—20 mL—of the liquid), followed by 2 mg after each loose bowel movement, not to exceed 16 mg (eight capsules) per day or 2 days of administration. With uncomplicated (no fever or blood in stools), watery diarrhea, this drug can be given to children age 2 years and older. Give children a 0.2 mg/kg (2.2 lb) of body weight dose every 6 hours. The liquid preparation contains 1 mg/tsp (5 mL). For adults, diphenoxylate (Lomotil) is an alternative, but has side effects of dry mouth and urinary retention. Pepto-Bismol is another, less effective choice (see page 212).

Kaopectate (kaolin plus pectin) is of limited value; it does not shorten the course of diarrheal illness, and acts only to add a little consistency to stools. Lactobacillus preparations (acidophilus beverages or yogurt) do not shorten the course of acute diarrheal illness, but they may be useful to repopulate the gastrointestinal tract with normal bacteria after a severe bout of diarrhea or administration of antibiotics used to treat diarrhea.

In foreign countries, drugs are on occasion recommended for diarrhea without a specific diagnosis. These drugs include chloramphenicol (Chloromycetin), Enterovioform, MexaForm, Intestopan, clioquinol, and iodoquinol. This may be dangerous, because these drugs can have certain adverse direct effects or side effects. Therefore, they should not be taken without a specific diagnosis for which they are felt to be indicated.

Antibiotics. These should be used if diarrhea is moderate to severe (more than eight bowel movements per day), particularly if it is bloody and associated with severe cramping, vomiting, and fever.

1. Administer ciprofloxacin (Cipro) 500 mg twice a day, or trimethoprim-sulfamethoxazole (Bactrim or Septra) one double-strength pill twice a day for 3 days. These will treat *E. coli* and *Shigella*, may be of use for *Salmonella*, and will not adversely affect the course of viral, *Staphylococcus*, or *Campylobacter* infections. The duration of cholera caused by *Vibrio cholerae* may be shortened by treating with azithromycin (1 g single dose), ciprofloxacin (1 g single dose; increasing resistance is being noted to this drug) or doxycycline (300 mg single dose) for adults, or trimethoprim-sulfamethoxazole for children (5 mg/kg, or 2.2 lb, of body weight, based on the trimethoprim component, for 3 days). Resistant strains are very common; for instance, in Bangladesh, cholera is resistant to tetracycline, erythromycin, and trimethoprim-sulfamethoxazole. Enteric fever caused by *Salmonella typhi* (typhoid fever) is best treated in adults with ciprofloxacin.

Alternative drugs include norfloxacin (Noroxin) 400 mg twice a day for 3 days, ofloxacin (Floxin) 200 or 300 mg twice a day for 3 days, or fleroxacin 400 mg once a day for 3 days. Another alternative drug is doxycycline (Vibramycin) 100 mg twice a day. Children younger than 12 years of age should not be given doxycycline, because it may cause

discoloration of the permanent teeth. Because ciprofloxacin may affect bone growth in children, it should only be given to adults.

If the clinical picture clearly points to *Giardia lamblia* (see page 216), administer metronidazole (Flagyl) 250 mg three times a day for 7 days. (A woman who is possibly pregnant should not use this drug except under the advice of her physician.)

Sometimes diarrhea is caused by antibiotic administration. This is called “*Clostridium difficile*–associated disease,” “antibiotic-associated diarrhea,” or “antibiotic-associated colitis.” It is caused by infection with the organism *Clostridium difficile*, which thrives in the bowel after the normal germs are killed by the initial antibiotic therapy. Another causative factor may be administration of a proton pump inhibitor drug, which lowers gastric acid, which helps *C. difficile* to survive and therefore be able to elaborate its toxin. Therapy against *C. difficile* is metronidazole (Flagyl) 500 mg by mouth three times a day or 250 mg by mouth four times a day, or vancomycin 125 mg by mouth four times a day for 10 days. It is important to note that *C. difficile* spores are not destroyed by disinfectant hand gels; thus handwashing remains extremely important to prevent the spread of this infectious organism.

Probiotics are harmless microorganisms (mostly bacteria and yeast) that are thought to provide health benefits. Examples include *Lactobacillus rhamnosus* and *casei*, which are found in certain yogurt products, and CULTURELLE, which is an all-natural dietary supplement containing the probiotic, *L. rhamnosus* GG (LGG). Probiotics, therefore, are a class of “friendly” bacteria that live in the digestive tract where they help to restore and maintain a healthy balance of “good” versus “bad” bacteria. They may be helpful in helping the bowel recover its normal function if ingested during and after a bout of diarrhea, particularly if antibiotics are used to treat the victim. They may also lessen the propensity for a person to develop *C. difficile* infection after being treated with an antibiotic for gastroenteric infection.

Traveler's Diarrhea

Traveler's diarrhea (“turista,” “Kathmandu quickstep,” “Montezuma's revenge,” “Delhi belly,” “Aztec two-step,” “Hong Kong dog,” and many other synonyms) is frequent, loose bowel movements (three or more loose stools in a 24-hour period associated with one or more of nausea, vomiting, abdominal cramps, fever, urge to defecate, cramping and straining with defecation, or bloody or mucus-laden stools) caused by waterborne or food-borne pathogens, most commonly produced by forms of the bacterium *Escherichia coli*, which is introduced into the diet as a fecal contaminant in water or on food. Someone has described it as “stool that fits the shape of the container.” When caused by *E. coli*, symptoms usually occur 12 to 36 hours after ingesting the bacteria, and include the gradual or sudden onset of

frequent (four to five per day) loose or watery bowel movements, rarely explosive, and far less violent than diarrhea associated with classic food poisoning (see below). Fever, bloating, fatigue, and abdominal pain are of minor to moderate severity. Nausea and vomiting are less frequently found than with viral gastroenteritis. Most traveler's diarrhea is caused by bacteria, but a small percentage may be caused by viruses or parasites.

The affliction will resolve spontaneously in 2 to 5 days if untreated, but may be hastened to a conclusion if an antibiotic is administered. The current recommendation is to treat adults with ciprofloxacin (Cipro) 500 mg twice a day for 1 to 3 days or a single dose of 1 g, norfloxacin 800 mg in a single dose, or azithromycin 1 g single dose (10 mg/kg [2.2 lb] of body weight in children once a day for 3 days). Trimethoprim-sulfamethoxazole (e.g., Bactrim or Septra) is no longer recommended for traveler's diarrhea, because of bacterial resistance. Another effective drug is rifamixin in a dose of 200 mg by mouth three times per day for 3 days. For known traveler's diarrhea, the addition of loperamide (Imodium A-D) to the antibiotic regimen can be of significant benefit, with the precaution that it should be used only in the absence of high fever or bloody diarrhea. Alternatively, the diarrhea can be treated with bismuth subsalicylate (Pepto-Bismol); give two 262 mg tablets (or the liquid equivalent) every 30 minutes for eight doses, which may be repeated the second day. Kaolin and pectin given orally in combination may make the stools less runny, but do not shorten the duration of the diarrhea. Yogurt and lactobacillus preparations are not effective treatments.

During the recovery period, it is fine to advance the diet fairly rapidly over a few days from clear liquids to bland foods to a normal diet.

To prevent traveler's diarrhea, a person traveling to high-risk regions with questionable hygiene and municipal water-disinfection standards (developing countries of Latin America, Africa, the Middle East, and Asia) can take rifamixin 200 mg once a day or ciprofloxacin 500 mg (or norfloxacin 400 mg or ofloxacin 200 mg) once a day, during the journey. Southern Europe (Spain, Greece, Italy, Turkey) and parts of the Caribbean pose a lesser risk. Another drug that can be used is doxycycline (Vibramycin) 100 mg twice a day. This should be done under the guidance of a physician, who will explain the risks (allergic reactions, blood disorders, antibiotic-associated colitis, vaginal yeast infection, skin rashes, photosensitivity) versus the benefits (particularly for those prone to infectious diarrhea or who would suffer unduly from an episode of severe diarrhea). Ingesting lactobacilli may improve certain aspects of digestion, but does not prevent traveler's diarrhea.

Alternatively, it has been recommended that you can drink 4 tbs (60 mL) of Pepto-Bismol (bismuth subsalicylate) four times a day; this necessitates carrying one 8 oz bottle for each day. The tablets (two 262 mg tablets four times a day) are less palatable. However, this prophylaxis is not intended to substitute for dietary discretion. In addition, large doses of bismuth subsalicylate can be toxic, particularly to people who regularly use aspirin. Anyone with an aspirin allergy should not use bismuth subsalicylate. Side effects include blackened stools and a black tongue, nausea, constipation, and ringing in the ears.

People who would be advised to consider taking a drug to prevent infectious diarrhea include those with a significant underlying medical problem (such as acquired immunodeficiency syndrome [AIDS], inability to produce stomach acid, or inflammatory bowel disease) and those with an itinerary rigid enough that it would be catastrophic to the mission to be laid up with diarrhea.

Some experts and the medical literature argue that conventional advice to avoid specific foods and liquids doesn't really help prevent traveler's diarrhea. However, on the chance that certain behaviors might be helpful, here are some commonly accepted notions. In general, it is safe to brush your teeth with foreign or mountain water, so long as you spit and don't swallow. Salads (particularly lettuce), raw vegetables, raw or undercooked meat (particularly hamburgers), raw or undercooked snails or seafood, unpeeled fruits and vegetables, cold sauces, ice cream, fresh cheese, spicy sauces in open containers, tap water, and ice are risky business. Fresh produce should, when possible, be purchased not bruised or damaged. Produce should not be packed with raw meat, poultry, or seafood products. Fruits and leafy vegetables should be washed in iodinated water, washed with dilute soap and previously boiled water, or immersed in boiling water for 30 seconds. In some underdeveloped countries, melons are injected with contaminated water to increase their weight before sale. Be cautious with buffets, food from street vendors, and the salads served on flights that originate from developing countries. Food prepared in restaurants in developing countries probably poses greater risk than does self-prepared food.

Probiotics have not yet been demonstrated to reduce the risk of traveler's diarrhea.

If possible, wash your hands with soap and water before you handle food or eat. If a disinfectant gel or lotion is available, use it, even after handwashing. This will significantly reduce the risk for transmission of bacteria and viruses that cause infections. Disinfectant gels do not provide protection, however, against spore-forming bacteria, such as *Clostridium difficile*, so handwashing retains its importance when this bacterium is a possible environmental contaminant.

In addition to proper handwashing (or wiping with disinfectant gel or cream) and disinfection of drinking water, there come a number of important actions, such as "food rules" (proper washing, cooking, and serving; what foods to avoid), bathroom hygiene, not sharing items such as towels and toothbrushes, and so on.

One important topic is how best to wash dishes to remove diarrhea-causing bacteria and viruses. One effective washing-up system is removal of most food residue with detergent (5 milliliters or 1 teaspoon) in the water in bowl 1, followed by a finishing wash (scrub until clean) with bleach (10 milliliters or 2 teaspoons of 4% chlorine bleach) in the water in bowl 2, followed by a final rinse in drinkable water in bowl 3. The final rinse is felt to remove the taste of the detergent and bleach (the latter considered to be a disinfectant). A few final recommendations are to use hot water in bowl 1, use a scouring pad or brush in bowl 2 with the bleach to avoid contamination of the scourer, allow all utensils to air dry after washing, and clean the washing-up bowls and allow them to dry between uses. Another suggestion is to use up to 100 milliliters or 20 teaspoons (3 teaspoons = 1 tablespoon) of bleach

in bowl 2 if there is a current outbreak of diarrhea and vomiting. This increases the disinfection power of the second bowl.

Water disinfection is discussed on page 433. Stick to boiled water, food that is served steaming hot, dry foods (bread), bottled carbonated beverages, and reputable food establishments. Alcohol in mixed drinks does not disinfect water. Packaged butter and packaged processed cheese are usually safe to eat. Unpasteurized dairy products should be avoided. Avoid casseroles, quiches, lasagna, and other foods that are prepared in advance and then may be allowed to sit for a prolonged period before consumption. During that time period, they can be contaminated by bacteria from fingers, insect legs, and contaminated serving utensils. With regard to seafood, raw or undercooked products, particularly shellfish, are especially hazardous. *Vibrio* organisms—which cause, among other problems, cholera—frequently reside in crabs and oysters. Cook all shellfish for a minimum of 10 minutes of boiling, or 30 minutes of exposure to full steam.

Viral Diarrhea

Traveler's diarrhea can also be caused by viruses. Viral gastroenteritis (commonly caused by rotaviruses [perhaps the most common cause of severe gastroenteritis in children less than 5 years of age] or Norwalk-like viruses) includes diarrhea as a symptom. Norovirus is a problem with outbreaks of diarrhea on cruise ships. Viral gastroenteritis is often associated with nausea and vomiting, fever, stomach cramps, copious rectal gas, and a flu-like syndrome. The diarrhea is typically watery, frequent (up to 20 movements per day), and often foul smelling, discolored (green to greenish brown), and without significant mucus or blood. Generally, the victim will have cyclic waves of lower-abdominal cramps, relieved by bowel movements.

Therapy requires continual oral hydration with clear liquids such as apple juice or broth. If they are available, drink electrolyte-containing sports beverages. It is critical to keep the victim from becoming dehydrated. What comes out below should be replaced from above.

The cramps can be controlled with propantheline bromide (Pro-Banthine), loperamide (Imodium A-D), or diphenoxylate (Lomotil), which will also help limit the diarrhea. It should be noted, however, that these drugs will slow down the activity of the bowel and allow any toxins that are in the gut to remain in contact with the bowel wall. With certain bacterial and viral infections, these drugs may prolong the carrier state and actually increase the severity and duration of the disease. Therefore, it is prudent to avoid the use of Imodium A-D or Lomotil unless the intake of fluids cannot keep pace with the diarrhea, and dehydration is becoming a real concern. *Never give an ant motility agent to an infant.* Imodium A-D can be used in children age 2 years and older if the diarrhea is clear (no blood) and watery, there is no associated fever, and diarrhea is leading to debilitating dehydration. Give a child a 0.2 mg/kg (2.2 lb) of body weight dose every 6 hours. The liquid preparation contains 1 mg/tsp (5 mL).

Cryptosporidiosis

Cryptosporidiosis is caused by *Cryptosporidium parvum*, which is commonly found in surface water in the United States. Infection is caused by ingestion of the oocysts, and is manifested by diarrhea, abdominal cramps, nausea and vomiting, fatigue, and low-grade fever. The cysts are 2 microns in diameter. Symptoms begin 2 to 10 days after ingestion, and may last for up to 2 weeks, with a carrier state of up to 2 months. The treatment is nitazoxanide 500 mg by mouth twice a day for 3 days in adults, and 100 mg twice a day in children up to age 12. Another effective treatment is azithromycin 500 mg by mouth once a day for 5 days in adults or paromomycin 500 mg three times a day for 7 days.

Food Poisoning

Food poisoning is caused by toxins that are produced by a number of bacteria, with the most common being *Staphylococcus*. Improper preservation (generally, lack of refrigeration) of food allows bacterial proliferation, which is not corrected by cooking. Typically, the symptoms occur 2 to 6 hours after eating and consist of severe abdominal cramps with nausea and vomiting. Diarrhea may be delayed by an hour or two, or may occur simultaneously with the nausea and vomiting. The diarrhea is often explosive. As with viral gastroenteritis, the bowel movements may be foul smelling and blood tinged. The disease is self-limited, and generally subsides after 6 to 12 hours. Treatment consists of rehydration with clear liquids. Antimotility drugs, such as loperamide (Imodium A-D) or diphenoxylate (Lomotil), may prolong the disorder, and should not be used unless the victim cannot replenish fluid losses.

E. coli O157:H7

Escherichia coli O157:H7 is a bacterium that has been transmitted by as few as 10 bacteria in raw or undercooked hamburger meat, fruit juices, and other food with fecal contamination. It can be spread person to person, and has also been transmitted by petting animals, contacting animal manure, and swimming in recreational pool water. After ingesting the bacteria, an infection may occur after an incubation period of 1 to 10 days, with 3 days being the average delay between exposure and illness. It causes a syndrome of fever or no fever, abdominal pain, vomiting, and nonbloody diarrhea, followed in a few days by bloody diarrhea, dehydration, weakness, anemia, and kidney failure. There is not yet an effective treatment with antibiotics. In fact, therapy with some antibiotics may contribute to more severe illness. Prevention means strict handwashing before eating and cooking ground beef until it is no longer pink (160°F). Do not mix raw and cooked foods, particularly meat. After you cook meat, do not serve it on the

unwashed dish that carried the raw food. Since raw meat, especially beef, can be a problem, be certain to wash hands, cooking utensils, cutting boards, dishes, and counters after they have been in contact with raw meat. Milk and fruit juices prepared from crushing processes require pasteurization. Understand that in the absence of pasteurization, which is a heating process, no product can be guaranteed to not be contaminated with the bacteria normally killed in the pasteurization process. Many of us like to drink fresh fruit juice. When we do so, we take a risk, usually, quite minor, that it may be contaminated. In the presence of someone with any cause of diarrhea, excellent handwashing technique should be observed. If a person is ill with a diarrheal illness, he or she should not prepare food for others or share common bodies of swimming or bathing water. Try to not swallow lake or swimming pool water.

For treatment of known or highly suspected *E. coli* O157:H7 infection, antibiotics are not recommended. This is because in some cases, antibiotics may worsen the affliction. The precise reason this happens is not known, but one suggestion is that by causing rapid death of large numbers of bacteria, the result is release of large amounts of the Shiga toxin (also known as verocytotoxin), which causes the medical problems. Antidiarrheal agents, such as loperamide (Imodium), are also not recommended, because they are thought to possibly keep the bacteria in contact with the bowel for longer periods of time. Most patients recover without antibiotics in approximately a week. Severely dehydrated individuals may require intravenous fluids. Children infected with *E. coli* O157:H7 are at higher risk than are adults for developing hemolytic-uremic syndrome, in which they may suffer kidney failure.

The difficulty with the recommendation to withhold antibiotics is that it is very difficult to make a precise field diagnosis of any particular cause of diarrhea.

Giardia Lamblia

Giardia lamblia is a flagellate protozoan (one-celled organism) that has become a worldwide problem, particularly in wilderness settings in the western United States, Nepal, and the Soviet Union. It is transmitted as cysts in the feces of many animals, which include humans, elk, beavers, deer, cows, dogs, and sheep. Dormant *Giardia* cysts enter water, from which they are ingested by humans. Cysts can live for up to 3 months in cold water.

If more than 10 to 25 cysts are swallowed, the organisms establish residence in the duodenum and jejunum (first parts of the small bowel), and after an incubation period of 7 to 20 days emerge in another form (trophozoite) to cause stomach cramps, flatulence, a swollen lower abdomen, often explosive and foul-smelling watery ("floating") diarrhea, "rotten" (sulfurous) belching, and nausea. Fever and vomiting are unusual except in the first few days of illness. Foul flatus and abdominal cramping are common. Because of the delay in onset after ingestion of the cysts, many a backpacker develops "backpacker's diarrhea" or "beaver fever" after he returns to civilization, and he does not make the

mental connection to his recent journey. If the diarrhea becomes chronic, the victim can lose appetite, lose weight, and become weak. Diagnosis is made by a physician who recognizes trophozoites or microscopic cysts in the stool of the victim, takes a sample of mucus from the duodenum, or is confident with a clinical diagnosis.

Untreated, the illness usually resolves after about 6 weeks. However, the diarrhea can go on for months. Therapy for *Giardia* infestation is the administration of metronidazole (Flagyl) 250 to 500 mg three times a day for 7 days. An alternative prescription drug is quinacrine hydrochloride (Atabrine) 100 mg twice a day for 7 days; the pediatric dose is 7 mg/kg (2.2 lb) of body weight per day in three divided doses for 7 days. Unfortunately, this drug has side effects (which occur in 1 to 4 out of every 1,000 people) that include making the person psychotic (lose touch with reality) for up to a few weeks. An excellent drug is tinidazole (Tiniba, Fasgyn), which is taken in a 2 g dose for 1 or 2 days; the pediatric dose is 50 mg/kg (2.2 lb) of body weight in a single dose. A good drug for children is furazolidone (Furoxone) 6 mg/kg of body weight in four divided doses for 7 days. There have been mixed reports of success with albendazole, given in a dose of 400 mg per day for 3 to 5 days. Particularly when an expedition will not reach civilization for 3 to 4 weeks, there is no reason to withhold treatment awaiting a definitive diagnosis. If the field diagnosis is correct, in most cases drug therapy will cause dramatic relief from symptoms within 3 days. There is no prophylactic drug that is recommended to prevent infestation.

Other Infectious Diarrheas

Diarrhea can be caused by a number of parasites and other infectious agents, which include *Campylobacter*, *Shigella*, *Salmonella*, *Yersinia*, *Vibrio*, and *Entamoeba histolytica* (and other amoebae). *Campylobacter jejuni* are the bacteria that most commonly cause diarrhea in the U.S., often noted after eating contaminated poultry. Although up to ¼ of persons who are infected are without symptoms, those who become ill frequently exhibit nausea, severe diarrhea, and abdominal pain. Amebic dysentery is caused by *E. histolytica*, the symptoms of which are diarrhea (frequently bloody, copious, and frequent) that does not respond to antibiotics, characterized by severe lower abdominal pain and a swollen abdomen. In an endemic area, presumptive field treatment is with metronidazole 500 mg by mouth three times a day for 10 days or with tinidazole 600 mg by mouth for 5 days. This is followed by eradication of the cyst forms remaining in the bowel wall with a drug such as paromomycin or diloxanide furoate.

Diarrhea-causing pathogens cause a constellation of fever, chills, nausea, vomiting, diarrhea (with or without mucus and blood), weakness, and abdominal pain. Because the clinical picture can be similar with infection from all of these organisms, the differentiation frequently relies on examination of the stool under the microscope and/or culture of the stool to identify the specific

pathogen. For the sake of the brief expedition, the treatment is the same: rehydration with copious amounts of balanced electrolyte solutions, and antimotility agents only when essential to prevent severe dehydration. If the victim suffers from high fever with shaking chills, has persistent bloody or mucus-laden bowel movements, or is debilitated by dehydration, he should seek the care of a physician. Meanwhile, the administration of ciprofloxacin (Cipro) 500 mg two times a day or azithromycin 500 mg once a day for 3 days will treat *E. coli* and *Shigella*, may eradicate *Salmonella*, and will not adversely affect other infections. As soon as the victim of persistent diarrhea returns to civilization, he should visit a physician for a thorough evaluation. If the ova or parasitic forms of amoebae are seen during microscopic examination of stool, other drugs, such as tinidazole, metronidazole, diloxanide furoate, paromomycin, or diiodohydroxyquin, may be prescribed. If the ova or parasitic forms of worms are seen, drugs such as mebendazole or pyrantel pamoate may be prescribed.

Irritable Bowel Syndrome

Irritable bowel syndrome (IBS, sometimes called spastic colitis, nervous colon, or irritable colon) is characterized by abdominal distention, the passage of flatus, cramping (pain) relieved by defecation, onset associated with change in frequency and/or form of the stool, and mucus-laden diarrhea. This can be debilitating. The sufferer may also complain intermittently of constipation. The onset of IBS is often associated with a change of the form of the stool (commonly loose or watery, or sometimes pellets). It is more common in women than men, and can be triggered by psychological stress. Many sufferers carry their own antidiarrheal or antispasmodic medication, such as loperamide or clidinium bromide with chlordiazepoxide (Librax). Constipation may be treated with laxatives such as lactulose or polyethylene glycol solution (see Constipation, below). Drugs that diminish hyperactivity of the bowel include dicyclomine hydrochloride and hyoscyamine sulfate. Diarrhea is treated with loperamide. Alosteron is used only for severe diarrhea-predominant IBS that does not respond after 6 months to conventional therapies. Irritable bowel is a diagnosis of exclusion that should be made by a physician. If a person is known to suffer from IBS with a constipation component, he should be encouraged to eat adequate fiber (indigestible plant carbohydrate: bran, steamed vegetables, or 20 to 30 g fiber supplement) and avoid coffee (caffeine), alcohol, fatty foods, and gas-producing vegetables. A useful prophylactic measure may be regular ingestion of a probiotic (e.g., *Lactobacillus* or *Bifidobacterium infantis* 35624) preparation. Regular exercise also appears to be helpful for some individuals. There are numerous therapies under investigation for persons with IBS that is refractory to all of these measures. These include antidepressants, serotonin-3 and serotonin-4 receptor antagonists, antibiotics, herbal therapy (including peppermint oil), and other agents to reduce the sensitivity and motility of the bowel.

CONSTIPATION

If a person becomes constipated (straining, difficult bowel movements with hard stools), the retention of stool and discomfort can be severe. Significant contributing factors to constipation are diet, dehydration, and lack of exercise. During outdoor activities, take care to drink fluids at regular intervals. In addition, sufficient fiber (bran, whole-grain cereals, vegetables, fruits) must be maintained in the diet. The “city backpacker” diet of chocolate bars, peanuts, and cheese sandwiches will turn the most irascible bowels into mortar. Regular, preemptive doses of a stool softener such as docusate sodium (Colace), or a bulking agent such as psyllium seed hydrophilic mucilloid (Metamucil), must be ingested with at least two glasses of water to be effective.

To relieve the victim of mild constipation, try the following measures:

1. Force fluids.
2. Adjust the diet (more for prevention than treatment).
3. Consider the use of a stool softener (mineral oil; docusate sodium: Colace, Regulax SS, Surfak); bulking agent (psyllium: Metamucil, Perdiem, Fiberall; methylcellulose: Citrucel; polycarbophil: Fibercon, Equalactin, Konsyl); osmotic laxative (magnesium hydroxide: Phillips' Milk of Magnesia; magnesium citrate: Evac-Q-Mag; sodium phosphate: Fleet Enema, Fleet Phospho-Soda, Visicol), natural laxative (prune juice), poorly-absorbed sugar (lactulose: Cephulac, Chronulac, Duphalac); polyethylene glycol and electrolytes: Colyte, GoLYTELY, NuLYTELY; polyethylene glycol: Miralax, and/or stimulant laxative (cascara sagrada: Colamin, Sagrada-lax; senna: Senokot, Ex-Lax; castor oil: Purge, Neoloid, Emulsoil). Peri-Colace is a combination of the stool softener docusate sodium and casanthranol, a laxative. Other drugs are listed on page 500.
4. In general, it is best to avoid the use of repetitive enemas or potent laxatives, because they can cause large fluid losses. A useful enema is a Colace 5 mL (200 mg) “microenema.” A child may benefit from a plain glycerin suppository. In general, enemas can cause cramping and bloating. If they contain electrolytes, such as magnesium or phosphate, they can cause elevated levels of these in the bloodstream. Typical enemas include 6 to 12 ounces of milk and an equal portion of molasses; 2 tablespoons of Epsom salts per quart of lukewarm water; 45 mL of Phospho-Soda with 2 quarts of water; 9 mL packet of Castile soap in 2 quarts of tap water; 30 mL of mineral oil in 1 to 2 quarts of water; and 1 to 2 quarts of warm (body temperature) tap water.
5. If a victim becomes impacted (has not had a bowel movement for 5 to 10 days due to constipation), using stool softeners will probably be ineffective, and piling on an ingested load of bulky fiber is just dumping more backfill behind the dam. Unfortunately, to break the roadblock, you may have to perform the physical removal of stool from the rectum, using a softening enema first and then a gloved finger for the extraction. This should be done gently, to prevent injury to the anus and walls of the

rectum. Two fingers are used to dilate the anus, then the stool is broken up with a scissoring motion. After as much stool as possible is removed manually, an enema should be used.

On a prolonged expedition, you should carry the stimulant laxative drug bisacodyl (Dulcolax). This is administered in oral (5 mg) or glycerin suppository (10 mg) form, with onset of effect in a few hours. Bisacodyl causes the bowel to contract, which can be extremely uncomfortable in someone with a large fecal impaction.

A useful drug to treat constipation is lactulose syrup 10 mg per tbsp (15 mL) of syrup. Administer 1 or 2 tbsp per day. Another method is polyethylene glycol solution (MiraLax) given as 17 g powder (1 heaping tbsp) dissolved in 8 oz (240 mL) of water taken daily for up to 4 days to initiate a bowel movement.

An elderly person with any significant change in bowel habits should see a physician on return to civilization.

HEMORRHOIDS

Hemorrhoids are enlarged veins that are found outside (external hemorrhoids) or inside (internal hemorrhoids) the anal opening (Figure 118). They cause problems that range from minor itching and skin irritation to excruciating pain, inflammation, and bleeding. The bleeding is noticed as bright red blood either on the outside of the stool (not mixed in with the excrement), in the toilet water, or on the toilet paper. Bleeding is usually sporadic, associated with difficult bowel movements (constipation) with straining, and passage of hard stools. To avoid problems, keep your stools soft. If hemorrhoids flare, the treatment is sitz (sitting)

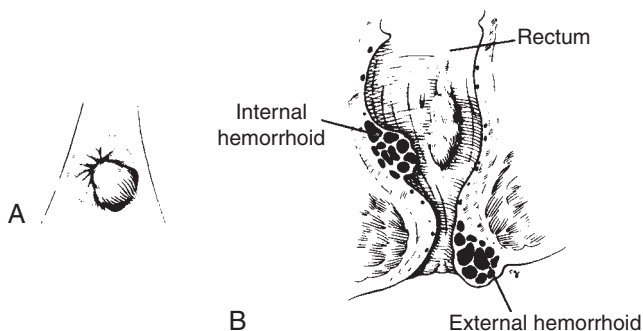


Figure 118. Hemorrhoids. **A**, External view of the anus with an enlarged external hemorrhoid. **B**, A cross-sectional view of the anus and rectum shows dilated veins that protrude into the rectum (internal hemorrhoids) and externally from the anus.

baths in warm water for 30 minutes three times a day, and the application of medication in the form of cream, ointment, or suppositories (Preparation H [essentially a petrolatum lubricant]; Anusol or Tronolane [with pramoxine 1% for pain and itching] or Anusol HC-1 [without pramoxine, but with hydrocortisone 1% for inflammation]; Nupercainal [1% dibucaine]; pramoxine hydrochloride 1% with hydrocortisone acetate 1% [proctoCream-HC]; ELA-Max 5 [lidocaine 5%] anorectal cream; Analpram-HC cream or ointment [hydrocortisone and pramoxine]). Unless bleeding is severe, it can be managed with sterile pads and gentle pressure. If the victim develops a fever associated with severe rectal pain or cannot pass a bowel movement, a physician should be sought.

A thrombosed hemorrhoid is one in which the blood has clotted within the dilated vein and formed a visible and palpable enlarged, hardened, and dark blue-purple knot. Pain is generally severe, and the victim may be unable to complete a bowel movement. The treatment usually involves incision through the wall of the vein and removal of the clot. Until the victim can be brought to a physician, warm soaks may ease the discomfort. Generally, all elderly people with rectal bleeding should be fully evaluated by a physician, to be sure that there is not another, more serious, cause.

FLATUS

The rectal passage of bowel gas offers relief and occasional embarrassment. If stomach cramps are due to excessive gas production, the drug of choice is simethicone (Mylicon or Mylicon-80), which causes dissolution of large gas collections and eases the passage of flatus. Charcoal Plus tablets and Flatulex tablets contain simethicone combined with activated charcoal, an absorbent. Beano food enzyme dietary supplement contains the enzyme alpha-galactosidase, which is advertised to be effective in preventing gas formation from vegetables, beans, and grains that contain indigestible sugars that ferment in the bowel to create gas. Because intestinal gas (methane) can be flammable, do not attempt to ignite rectal gas or direct the stream of gas into a campfire. Backflashes and minor burns are a real risk.

HEARTBURN

Heartburn is a manifestation of esophageal reflux (in medical parlance, sometimes called gastroesophageal reflux disease [GERD]), in which stomach contents containing acid and food travel backward from the stomach into the esophagus. This causes irritation and pain, which is typically sharp or burning and located under the breastbone and/or in the upper abdomen. It may be associated with belching, a sour taste in the mouth, and/or near-vomiting. When severe, the pain may be confused with angina (see page 49). Omeprazole (Prilosec) is a drug that suppresses gastric acid secretion. It can be prescribed

for a 1- to 2-week period by a physician for GERD or for up to a 4- to 8-week period for severe erosive inflammation of the esophagus (adult dose 20 to 40 mg by mouth in the morning and 20 mg in the evening). Other drugs in this category (“proton pump inhibitors”) are pantoprazole (Protonix) and rabeprazole (AcipHex). Mild heartburn is often managed with antacids, particularly Gaviscon, which forms a “foam” that floats on the stomach contents and protects the esophagus from refluxed acid. Metoclopramide hydrochloride (Reglan) helps control muscle tone at the sphincter (junction) between the stomach and the esophagus, and thus helps prevent reflux. Nizatidine 75 mg (Axid AR [“acid reducer”]) is an H₂-blocker drug (see page 501) that inhibits gastric acid secretion. It is swallowed 30 to 60 minutes before eating, and can be used up to twice in 24 hours. Cimetidine (Tagamet) 200 mg can be used in a similar manner. Famotidine (Pepcid AC) 10 or 20 mg twice a day (preferably ingested 15 to 60 minutes before eating) for up to 6 weeks is another therapy.

Keep meals small, and do not eat them immediately before reclining (no bedtime snacks). Known gastric irritants (alcohol, cigarettes, pepperoni sandwiches) should be avoided. If possible, sleep with the head of your bed or sleeping bag elevated. Occasionally, it is necessary to sleep in the sitting position, to counteract the forces of gravity and a loose esophageal sphincter. Wear loose-fitting clothing around the stomach. Weight loss is advised for overweight or obese persons.

NAUSEA AND VOMITING

Nausea and vomiting may arise from causes as simple as anxiety, or may represent a serious problem such as appendicitis, ingestion of a poisonous plant, or response to a head injury. When vomiting is secondary to a serious underlying disorder, the basic problem must be remedied. Any victim with nausea and vomiting who suffers from altered mental status, uncontrollable high fever, extreme abdominal pain, or chest pain that might represent heart disease—or who is either very young or very old—should be evacuated promptly. Anyone who vomits blood should be taken to a hospital immediately. Vomiting in children is particularly worrisome if it accompanies head trauma (see page 61), abdominal trauma (see page 119), or lethargy or confusion (which might represent an infection or poisoning); severe vomiting (which might represent a bowel obstruction [see page 127] or appendicitis [see page 126]) is also of concern.

If nausea and vomiting due to gastroenteritis become excessive, they can be managed with an antiemetic. One effective drug is ondansetron (Zofran). The adult dose is one 4 mg dissolving tablet every 8 hours; the pediatric dose is 0.15 mg/kg of body weight of the oral dissolving tablet every 6 to 8 hours. Alternative drugs are prochlorperazine (Compazine), which can be administered orally or as a suppository, promethazine (Phenergan), which comes in suppository

form, or trimethobenzamide (Tigan), which can be taken orally or by suppository. If the victim is so ill that he cannot keep anything in his stomach, it makes no sense to administer an oral medication, so an injection or suppository must be used. A person who requires medication to control vomiting should see a physician. After multiple episodes of vomiting, the victim may suffer from dehydration (see page 207), particularly if there is associated diarrhea as part of a gastroenteritis. Fluid replacement is essential. The diet should be advanced slowly as the victim's hunger returns.

Nausea and vomiting due to motion sickness are discussed on page 440. Cyclical vomiting is a disorder in which the victim experiences fatigue and nausea, and perhaps sweating and pale skin color for approximately 90 minutes before onset of explosive vomiting, which may last for up to 24 hours in children and 3 days in adults. The victims may vomit up to 6 times per hour. This disorder, which may sometimes be accompanied by abdominal pain, can be triggered by stress, an upper respiratory tract infection, menses, sleep deprivation, certain foods, asthma attacks, motion sickness, or environmental allergies. Treatment is supportive and based on symptoms. If an attack is severe, the victim may require intravenous hydration.

VOMITING BLOOD

Bleeding from the gastrointestinal tract can cause the victim to vomit blood (either bright red or dark brown "coffee grounds"). If the blood is not vomited, it passes through the bowels and emerges as dark black tarry stools (melena) or occasionally as maroon clots or bright red blood. Brisk bleeding in the stomach or bowels may be painless; any bleeding should be considered serious. Even if the bleeding episode is brief (except for bleeding from known hemorrhoids), the victim should be evacuated immediately to a hospital. If the victim is known to have ulcer disease and ceases vomiting, antacids should be given by mouth.

Persistent retching can cause the stomach wall to tear and begin to bleed. For this reason, persistent nausea and vomiting from any cause should be controlled with medications, if possible.

ULCER DISEASE

A gastric ulcer is an erosion into the stomach. A peptic ulcer is an erosion into the duodenum (first portion of the small bowel) that is worsened by the constant assault from gastric acid and digestive juices. Many ulcers are caused by infection of the inner lining of the stomach and bowel with the microorganism *Helicobacter pylori*, which can be eradicated with an intensive course of multiple antibiotics. Such therapy is undertaken not in the field, but under the supervision of a physician.

The major symptom of ulcer disease is burning, sharp, or aching pain in the upper abdomen that is usually relieved by the ingestion of food or antacids, although the latter alone may be therapeutic. Classically, the pain occurs when the stomach is empty, particularly during times of emotional stress. Because the greatest amounts of acid are secreted following meals and between the hours of midnight and 3:00 A.M., these are times when pain is most frequent.

If the victim is strongly suspected or known to have an ulcer, and can control the pain readily with medications, the journey can continue. Make every attempt to keep on a regular meal schedule and to take medication properly during waking hours. As noted below, cigarette smoking and alcohol ingestion are strictly prohibited. If pain is not immediately controlled, or if there is any suggestion of bleeding or perforation, rapid transport to a hospital is indicated.

Therapy

1. *Antacids.* These are the traditional mainstay of therapy and should be taken in a dose of 2 to 3 tbsp (30 to 45 mL) 1 and 3 hours after meals, at bedtime, and as necessary to control pain. Liquids are generally more effective than tablets. Solid food and milk are not recommended as antacids. While they may decrease pain briefly, they actually stimulate the secretion of acid.
2. *Drugs to inhibit the secretion of acid.* Medications used to decrease acid secretion (antagonists to histamine H₂ receptors [H₂RAs] and proton [acid] pump inhibitors [PPIs]) decrease bowel activity and cramping.
3. *Drugs to protect the lining of the gastrointestinal tract.* Sucralfate (Carafate) is a drug that binds with the ulcer and protects the bowel lining from further erosion. Because it requires the presence of acid in the ulcer crater to be activated, it should not be given at the same time as antacids.
4. *Avoidance of alcohol, tea, coffee, tobacco, and known gastric irritants.*
5. *Do not use household baking soda to neutralize acid in the stomach.* Baking soda (bicarbonate) reacts with the acid to liberate heat and gas.

HEPATITIS

Hepatitis is inflammation of the liver that is caused by viral infection or parasitic infestation, drugs, toxic chemicals, alcohol abuse, or autoimmune disease. Type A infectious (short-incubation) hepatitis is the more commonly encountered viral form. The virus is excreted in urine and feces and contaminates drinking water and food products (such as raw shellfish). Type B infectious (long-incubation) hepatitis is caused by a virus found in many body fluids (blood, saliva, semen) and is spread

by direct person-to-person contact. Type C infectious hepatitis (formerly non-A, non-B hepatitis) is caused by at least one virus and is most commonly associated with blood transfusions. Multiple other forms of viral hepatitis have been discovered by medical researchers.

Hepatitis causes the victim to have a constellation of signs and symptoms, which include yellow discoloration of the skin and eyes (jaundice—from the buildup of bilirubin pigment, which the diseased liver cannot process properly), nausea and vomiting, fatigue, weakness, fever, chills, darkened urine, diarrhea, pale-colored bowel movements (which may precede the onset of jaundice by 1 to 3 days), abdominal pain (particularly in the right upper quadrant over the swollen and tender liver), loss of appetite, joint pain, muscle aching, itching, and red skin rash. A young child may suffer from type A infection, yet show only a mild flu-like illness.

Anyone suspected of having hepatitis should be placed at maximum rest and transported to a physician. Avoid alcohol and medication ingestion, because the metabolism of many drugs is altered in the victim with a diseased liver. He should be encouraged to avoid dehydration and should maintain adequate food intake. If the cause of hepatitis is viral, the victim's disease may be contagious for his first 2 weeks of illness. Do not share eating utensils or washrags. Body secretions (saliva and waste products) frequently carry the virus; therefore, pay strict attention to handwashing. Sexual contact should be avoided during the infectious period. In no case should a needle used for injection of medicine into one person be reused for another individual.

Protection against hepatitis is best accomplished by prevention of virus transmission through good hygiene. Hepatitis A vaccine is available (see page 454). In countries of high hepatitis incidence (poor sanitation, infested water or food), pooled immune serum globulin (ISG, or gamma globulin) injections are advised (see page 454); these protect unimmunized people against hepatitis A, and diminish symptoms in infected people. In a recent study that compared hepatitis A vaccine against ISG for postexposure prophylaxis against hepatitis A in persons who had not been previously immunized, it appeared that they were roughly equivalent, with the ISG being slightly more effective at preventing hepatitis A. Hepatitis B vaccine (see page 454) is intended for health care workers or those who will visit or reside in regions of high endemicity. It is of little benefit against hepatitis A.



SKIN DISORDERS

SUNBURN

The solar radiation that strikes the earth includes 50% visible light (wavelength 400 to 760 nanometers [nm]), 40% infrared (760 to 1,700 nm), and 10% ultraviolet (UV) (10 to 400 nm) (Figure 119). Energetic rays (e.g., cosmic rays, gamma rays, and x-rays) with wavelengths shorter than 10 nm do not penetrate to the earth's surface to any significant degree. Sunburn is a cutaneous photosensitivity reaction caused by exposure of the skin to ultraviolet radiation (UVR) from the sun. There are four types of UVR: vacuum UVR is 10 to 200 nm (absorbed by air and unable to penetrate Earth's atmosphere), UVA is 320 to 400 nm, UVB is 290 to 320 nm, and UVC is 100 to 290 nm. UVC is filtered out by the ozone layer of the atmosphere. UVB is the culprit in the creation of sunburn and cancer. UVA is of less immediate danger but is a serious cause of skin aging, drug-related photosensitivity, and skin cancer. Furthermore, persons taking immunosuppressive agents for medical reasons (e.g., acquired immunodeficiency syndrome [AIDS] or cancer) may be more predisposed to skin cancer caused by UVA.

Ultraviolet exposure varies with the time of day (greatest between 9 A.M. and 3 P.M. because of increased solar proximity and decreased angle of light rays), season (greater in summer), altitude (8% to 10% increase per each 1,000 ft, or 305 m, of elevation above sea level), location (greater near the equator), and weather (greater in the wind). Snow or ice reflects 85% of UVR, dry sand 17%, and grass 2.5%. Water may reflect 10% to 100% of UVR, depending on the time of day, location, and surface. However, UVR at midday may penetrate up to 24 in (60 cm) through water. Clouds absorb 10% to 80% of UVR, but rarely more than 40%. Most clothes reflect (light-colored) or absorb (dark-colored) UVR. A dry white cotton shirt has a maximum sun protection factor (SPF) of 8 (see Sunscreens, below). However, it is important to note that wet cotton of any color probably transmits considerable UVR.

Skin darkening occurs immediately on UVA exposure, as preformed melanin is released, and lasts for 15 to 30 minutes. Tanning occurs after 3 days of exposure, as additional melanin is produced. If the skin is not conditioned with gradual doses of UVR (tanning), a burn can be created. A person's sensitivity to UVR depends on his skin type and thickness, the pigment (melanin) in his skin, and weather conditions. Well-hydrated skin is penetrated four times as effectively by UVR as is dry skin, because the moist skin does not scatter or reflect UVR as well.

Depending on the exposure, the injury can range from mild redness to blistering and disablement. Rapid pigment darkening from immediate melanin release is followed by the redness with which we are all familiar, caused by dilation of superficial blood vessels. This begins 2 to 8 hours after exposure and reaches its maximum (the "burn") in 24 to 36 hours, with associated itching and pain.

Higher Energy
Shorter Wavelength

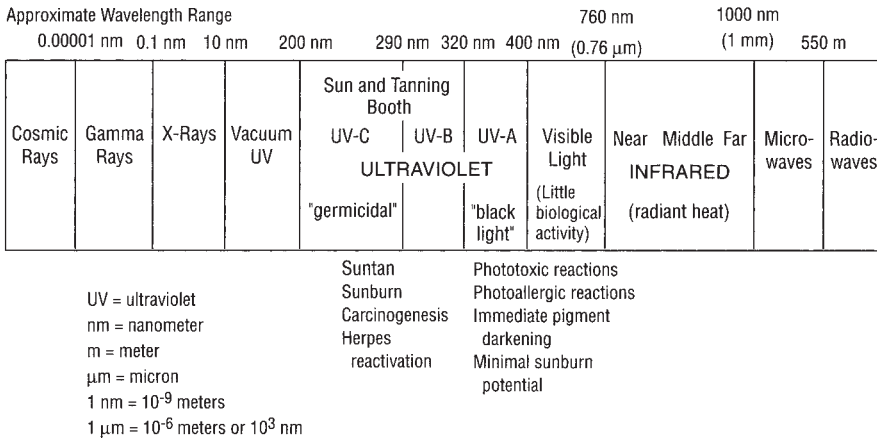


Figure 119. Solar radiation.

Wind appears to augment the injury, as do heat, atmospheric moisture, and immersion in water. "Windburn" is not possible without UVR or abrasive sand. Since windburn is due in part to the drying effect of low humidity at high altitudes, it can be helpful to protect the skin with a greasy sunscreen or barrier cream.

People may be more sensitive to UVR after they have ingested certain drugs (such as tetracycline, doxycycline, fluoroquinolones, vitamin A derivatives, non-steroidal antiinflammatories, sulfa derivatives, minoxidil, diltiazem, nifedipine, thiazide diuretics, hypoglycemic agents, chloroquine, dapsone, quinidine, carbamazepine, chemotherapeutic drugs, and barbiturates) or have been exposed to certain plants (such as lime, citron, bitter orange, lemon, celery, parsnip, fennel, dill, wild carrot, fig, buttercup, mustard, milfoil, agrimony, rue, hogweed, Queen Anne's lace, and stinking mayweed). Your eyes may become more sensitive to light (e.g., you may need to wear sunglasses at a lower UV threshold) if you are taking certain medications, such as digoxin, quinidine, tolazamide, or tolbutamide.

For a mild sunburn in which no blistering is present, the victim may be treated with cool liquid compresses, cool showers, a nonsensitizing skin moisturizer (such as Vaseline Intensive Care), and aspirin or a nonsteroidal antiinflammatory drug, such as ibuprofen, to decrease the pain and inflammation. Topical anesthetic sprays, many of which contain benzocaine and/or diphenhydramine, should in general be avoided, because they can cause sensitization and an allergic reaction. Menthol-containing lotions may be helpful. Topical steroids do not appreciably diminish a sunburn.

If the victim is deep red ("lobster") without blisters, a stronger antiinflammatory drug, such as prednisone, may be given. A 5-day course of prednisone (80 mg on the first day, 60 mg the second, 40 mg the third, 20 mg the fourth, and 10 mg the fifth) may decrease the discomfort of "sun poisoning," which is

the constellation of low-grade fever, loss of appetite, nausea, and weakness that accompanies a bad total-body sunburn. Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head (“ball” of the ball-and-socket joint) of the femur, the long bone of the thigh. An extensive nonblistering first-degree sunburn can make the victim nauseated and weak, with low-grade fever and chills. He should be forced to drink enough balanced electrolyte-supplemented liquids to avoid dehydration (see page 208).

Topical steroid creams, such as pramoxine with hydrocortisone (Pramosone cream or lotion) may be used if blisters are not present. Pramoxine alone (Prax) is a nonsensitizing topical anesthetic. Topical steroid preparations should not be applied to blistered skin, because wound healing may be delayed and infection made likelier. On the other hand, aloe vera lotion or gel may be soothing and promote healing. Vitamin E is an antioxidant that, when mixed with aloe vera, may soothe the skin. However, this hasn’t been proven to promote healing any better than aloe vera alone. Other remedies that have been suggested include bathing in a tub of water augmented by baking soda or oatmeal, or applying 0.1% diclofenac gel.

With a severe sunburn in which blistering is present, the victim has by definition suffered second-degree burns (see page 108) and should be treated accordingly. Gently clean the burned areas and cover with sterile dressings. Administer appropriate pain medication.

SUNSCREENS

Sunscreens (available as lotions or creams) either absorb light of a particular wavelength, act as barriers, or reflect light. There is no evidence that any ingredients in sunscreens cause skin damage or cancer. Choose sunscreens based on your estimated exposure and on your own propensity to tan or burn. There is no such thing as a “safe tan,” even when sunscreens are used, because sun exposure is directly linked to skin cancer. In addition, long-term exposure to UVR from sunlight causes premature skin aging and loss of skin tone. The term *photoaging* refers to these effects—increased wrinkles, loose skin, brown spots, a leathery appearance, and uneven pigmentation.

Dermatologists classify sun-reactive skin types (based on the first 45 to 60 minutes of sun exposure after winter or after a prolonged period of no sun exposure) as follows:

Type I. Always burns easily, never tans. (Fair-skinned people with a high number of moles are at the greatest risk for melanoma.)

Type II. Always burns easily, tans minimally.

Type III. Burns moderately, tans gradually and uniformly (light brown).

Type IV. Burns minimally, always tans well (moderate brown).

Type V. Rarely burns, tans profusely (dark brown).

Type VI. Never burns, is deeply pigmented (black skin).

In all cases it is wise to overestimate the protection necessary and to carry a strong sunscreen. To protect hair from sun damage, wear a hat.

Para-aminobenzoic acid (PABA) derivatives, which are water soluble, are sunscreens that absorb UVB (not UVA) and that accumulate in the skin with repeated application. The most commonly used PABA derivative is padimate O (octyl dimethyl PABA). The most effective method of application is to moisturize the skin (shower or bathe) and then apply the sunscreen. For maximum effect, chemical sunscreens should be applied liberally (most people only apply $\frac{1}{4}$ to $\frac{1}{2}$ of what they need) at least 15 to 30 minutes before exposure, and the skin should be kept dry for at least 2 hours after sunscreen application. Sun blockers, such as titanium, are effective essentially immediately. When PABA itself is used, a recommended preparation is 5% to 10% PABA in 50% to 70% alcohol. However, PABA is now used infrequently because its absorption peak of UVB at 296 nm is too far from 307 nm, where UVB exerts its greatest effect. Furthermore, it causes skin irritation—a stinging sensation—and can stain cotton and synthetic fabrics. PABA derivatives are less problematic.

Benzophenones are sunscreens that are more effective against UVA. These should be used in 6% to 10% concentration. Because they are not well absorbed by the skin, they require frequent reapplication. Photoplex broad-spectrum sunscreen lotion contains a PABA-ester combined with a potent UVA absorber, Parsol 1789. This is an excellent sunscreen for sensitive people, particularly those at risk for drug-induced photosensitivity. The Food and Drug Administration (FDA) has approved Anthelios SX (L'Oreal), which has SPF (see below) 15 and contains three active ingredients, one of which is ecamsule (a stable UVA sunscreen), which has been marketed as Meroxyl SX in Europe and Canada since 1993. Sunscreens come in different concentrations (such as PreSun "8" or "15"). A higher sun protection factor (SPF) number (range 2 to 50) indicates a greater degree of protection against UVB. "Minimal erythema dose" (MED) is the amount of UVR exposure required to redden the skin. SPF is derived by dividing the MED of skin covered with sunscreen by the MED of unprotected skin. Thus, an SPF of 15 indicates that it requires 15 times the UVR exposure to achieve a sunburn as it would without protection. The SPF number assumes a liberal (approximately $1\frac{1}{4}$ oz, or 37 mL, per adult) application of the sunscreen. In general, a sunscreen with an SPF number of 8 or less will allow tanning, probably by ultraviolet A exposure. There is no standard for measuring UVA protection. Persons with sensitive or unconditioned skin should use a sunscreen with an SPF number of 10 or greater. Fair-skinned people who never tan or who tan poorly (Types I, II, or III) or mountain climbers (there is more UV exposure at higher altitudes, and more is reflected off snow) should always use a sunscreen with an SPF number of 15 or greater. Most sun exposure occurs before age 18 years, so it is very important to apply sunscreens to children and young adults.

Substantivity refers to the ability of a sunscreen to resist water wash-off. Layering sunscreens doesn't work well, because the last layer applied usually washes off. Current specialty sunscreens with high substantivity include Bullfrog Water

Pro Body Gel, Aloe Gator Total Sun Block Lotion, and Dermatone Ultimate Fisherman's Sunscreen.

Sunscreens are first applied to cool, dry skin for optimal absorption; wait 10 minutes before water exposure. Reapply them liberally after swimming or heavy perspiration. In general, most sunscreens should be reapplied every 20 minutes to 2 hours. Be aware that the concomitant use of insect repellent containing DEET (see page 390) lowers the effectiveness of the sunscreen by a factor of one-third. Although many sunscreens are designed to bond or adhere to the skin under adverse environmental conditions, there are certain situations in which *any* sunscreen should be reapplied at a maximum of 3- to 4-hour intervals:

- Continuous sun exposure, particularly between the hours of 10 A.M. and 3 P.M.
- Exposure at altitude of 7,000 ft (2,135 m) or higher
- Exposure within 20 degrees latitude of the equator
- Exposure during May through July in the Northern Hemisphere, and December through February in the Southern Hemisphere
- Frequent water immersion, particularly with toweling off
- Preexisting sunburn or skin irritation
- Ingestion of drugs, such as certain antibiotics, that can cause photosensitization

Some authorities recommend using sunscreens of at least SPF 29, with the rationale that most people underapply or improperly apply them. Bald-headed men should protect their domes. All children should be adequately protected. However, avoid PABA-containing products in children less than 6 months old. Those sensitive to PABA can use Piz-Buin, Ti-Screen, Sawyer Products Stay-Put Sun Block, Uval, and Solbar products. Eating PABA does not protect the skin.

For total protection against ultraviolet and visible light, a preparation can be composed from various mixtures of titanium dioxide, red petrolatum, talc, zinc oxide, kaolin, red ferric oxide (calamine), and ichthammol. These preparations or similar commercial products ("glacier cream") are used for lip and nose protection. Micronized titanium dioxide and zinc oxide can be prepared in an invisible preparation (such as Ti-Screen Natural 16 and Neutrogena Chemical Free 17) that does not cause skin irritation. Sunscreens that prevent infrared transmission may help prevent flares of fever blisters caused by herpes virus. An improvised sunscreen can be prepared by preparing a sludge of ashes from charcoal or wood, or from ground clay. In a pinch, axle grease will work to some degree.

If you are concerned about jellyfish stings, a useful product is Safe Sea Sunblock with Jellyfish Sting Protective Lotion (www.buysafesea.com), which is both a sunscreen and a jellyfish sting inhibitor.

Substances that are ineffective as sunscreens and that may increase the propensity to burn include baby oil, cocoa butter, and mineral oil. Promising antioxidant substances under investigation as effective sunscreens are vitamins A, C, and E, and chemicals found in green tea.

Although "tanning tablets" or "bronzers" induce a pigmentary change in the skin that resembles a suntan, they provide minimal, if any, true protection from

the effects of ultraviolet exposure. Like the sun, indoor tanning machines induce skin changes that lead to premature skin aging and cancer. The best tan derived from the natural sun's UVB carries an SPF of approximately 2; a tanning bed supplies UVA and therefore no protection.

Taking aspirin or a nonsteroidal antiinflammatory drug (such as ibuprofen) at 6-hour intervals three times before sun exposure may help protect the sun-sensitive person.

Many effective sunscreens, particularly those advertised to stay on in the water, are extremely irritating to the eyes, so take care when applying these to the forehead and nose. Near the eyes, avoid sunscreens with an alcohol or propylene glycol base. Instead, use a sunscreen cream.

There are also sunscreen/insect repellent combinations, such as Coppertone Bug & Sun. Avon Bug Guard contains Skin-So-Soft (mostly mineral oil) in combination with picaridin or IR3535, and in at least one version, it is enhanced by a sunscreen.

A line of medical clothing, Solumbra by Sun Precautions, is advertised to be "soft, lightweight and comfortable," and offers 30-plus SPF protection. Solar Protective Factory also manufactures high-SPF protective clothing. Women's hosiery has an unacceptably low SPF. The ability of Lycra to block UVR varies depending on whether it is lax (very effective) to stretched (nearly ineffective). Dry, white cotton (T-shirt) has an SPF of 5 to 8. The ultraviolet protection factor (UPF) is a measure of UVR protection provided by a fabric. Thus, a UPF of 15 indicates that $\frac{1}{15}$ of the UVR that strikes the surface of the fabric penetrates through to the skin. A chemical UVR protectant, Tinosorb FD (Rit Sun Guard), may be used as a laundry additive, increasing the UPF of washed clothing up to 50.

UVR protection provided by hats depends on the style. Broad-brimmed hats and "bucket" hats provide the most protection for the face and head. Sunday Afternoons manufactures comfortable broad-brimmed hats with neck shields advertised to provide 97% UV block. Legionnaires hats do a decent job of protection, but baseball caps leave many facial areas exposed. If you are wearing a helmet, add a visor.

MELANOMA

Melanoma is a type of skin cancer that can be caused by ultraviolet B light exposure. Indeed, regular use of a sunscreen with an SPF of at least 15 during the first 18 years of life may reduce the lifetime risk of developing melanoma by more than 75%. People with white skin and a tendency to burn rather than tan are at increased risk for the development of melanoma.

Although you wouldn't self-treat a melanoma, it is important for those who spend a great deal of time outdoors to recognize the features of skin cancer. Regularly inspect existing moles, birthmarks, and other skin lesions. Since melanoma is often found on a person's back or other area that cannot be easily inspected, it is important to have a knowledgeable person (such as a dermatologist) inspect all suspicious skin lesions from time to time.

Warning signs within a skin lesion include the following:

1. Irregular, ragged, jagged, notched, or blurred border.
2. Asymmetrical appearance (one portion different from the rest, with respect to color, darkness, or texture).
3. Change in appearance or features (size, color, texture, sensation); onset of pain in a lesion; rapid growth of a lesion.
4. Recent growth, bleeding, itching, scaling, or tenderness.
5. Discoloration (black, dark brown, blue, red, white, mottled).

If you note any of these features, see a dermatologist for a proper evaluation. Basal cell carcinoma and squamous cell carcinoma are two other types of cancer associated with UVR exposure.

POISON IVY, SUMAC, AND OAK (GENUS *TOXICODENDRON*)

The rashes of poison ivy, poison sumac, and poison oak are caused by a resin (urushiol) found in the resin canals of leaves, stems, vines, berries, and roots (Figure 120). The resin is not found on the surface of the leaves. The potency of the sap does not vary with the seasons. In its natural state, the oil is colorless; on exposure to air, oxidation causes it to turn black. Because the plant parts have to be injured to leak the resin, most cases are reported in spring, when the leaves are most fragile. Dried leaves are less toxic, because the oil has returned to the stem and roots through the resin canals. However, smoke from burning plants carries the residual available resin in small particles and can cause a severe reaction on the skin and in the nose, mouth, throat, and lungs.

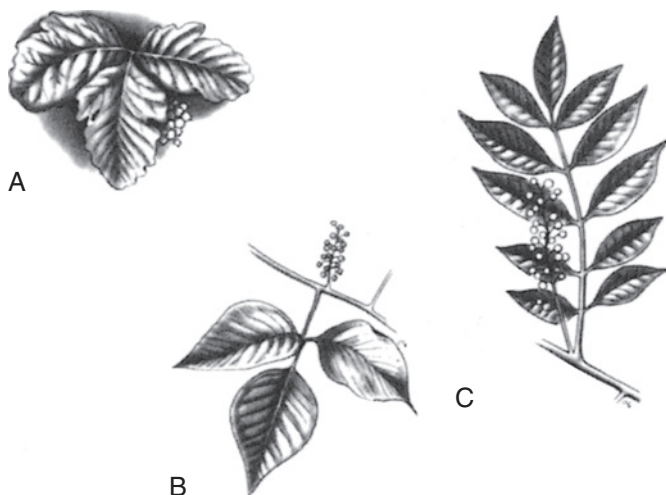


Figure 120. A, Poison oak. B, Poison ivy. C, Poison sumac.

The poison oak group does not grow in Alaska or Hawaii, and it rarely grows above 4000 ft (1219 m). Other plants or parts of plants that contain urushiol include the India ink tree, mango rind, cashew nut shell, and Japanese lacquer tree. A smaller number of reactions are caused by the poisonwood tree found in the southern tip of Florida. Because the resin is long lived, it can be spread by contact with tents, clothing, and pet fur.

Sensitivity to the resin varies with each individual, and can present for the first time at any age. The first exposure produces a rash in 6 to 25 days. Subsequent exposures can cause a rash in 8 hours to 10 days, with a 2- to 3-day interval most common. Unless the resin is removed from the skin within 10 minutes of exposure, a reaction is inevitable in sensitive individuals. It is generally accepted that the resin binds to the skin within 30 minutes, is completely bound to the skin within 8 hours, and is likely impossible to remove effectively with soap and water after just 60 minutes. Some highly sensitive persons will suffer a reaction even if the resin is washed off within 1 minute of exposure.

The rash begins with itching followed by redness, followed by lines of reddened bumps and blisters. The skin may swell, blisters grow, and weeping/oozing lesions develop. Swelling of the tissues can be quite severe. After approximately a week, the rash begins to dry, and scabs begin to form, particularly if the victim has done much scratching and rubbing. This is followed by thickening and darkening of the skin, which may last for many weeks.

After exposure, it is usually most convenient to remove the resin with soap and cool water, but to be most effective, washing must occur within 30 minutes. Rubbing alcohol is a better solvent for the resin than is water. Zanafel Poison Ivy Wash (Zanafel Laboratories) is a soap mixture of ethoxylate and sodium lauroyl sarcosinate surfactants that binds to urushiol on the skin so that it can be washed off. The instructions for use (to treat an area the size of an adult hand or face) are to wet the affected area; squeeze a minimum 1½ inch ribbon of Zanafel into one palm and then wet and rub both hands together for 10 seconds to work the product into a paste; rub both hands on the affected area for up to 3 minutes to work the Zanafel into the skin until there is no itching; and rinse the area thoroughly. If the itch returns, repeat the process. Tecnu Outdoor Skin Cleanser (alkane and alcohol) (Tec Labs) works quite well when applied soon after exposure, rubbed in for 2 minutes, and rinsed off, with a repeat of the entire sequence. Tecnu Extreme Medicated Poison Ivy Scrub is advertised to be effective after a 15-second application. Another wash designed to remove urushiol is Dr. West's Ivy Detox Cleanser, which contains magnesium sulfate. Herbal remedies that have been claimed (but never proven) to be effective are jewelweed (*Impatiens capensis*), which is an ingredient in Burt's Bees Poison Ivy Soap, witch hazel bark, and aloe plant.

For treatment of the skin reaction, shake lotions such as calamine are soothing and drying, and they control itching. A good nonsensitizing topical anesthetic is pramoxine hydrochloride 1% (Prax cream or lotion); Caladryl

contains calamine and pramoxine. Avoid topical diphenhydramine, benzocaine, and tetracaine. Antihistamines (such as diphenhydramine [Benadryl]) control itching and act as sedatives. Nonsedating antihistamines, such as fexofenadine (Allegra), may also diminish itching. A soothing bath in tepid (not hot) water with half a 1 lb box of baking soda, 2 cups (551 mL) of linnet starch, or 1 cup (275 mL) Aveeno oatmeal is excellent. If Aveeno is not available, a woman's nylon stuffed with regular (not instant) oatmeal can be thrown in the tub. Soothing aluminum acetate in water (1:20) soaks may help, as might aluminum subacetate (Burow's solution, Domeboro), which comes as a 5% solution that should be diluted to a 1:40 concentration. When these soaks are used, they should be applied as cotton-soaked wet dressings 3 to 4 times a day for 15 to 30 minutes per application to dry out the weeping rash. Topical steroid creams are generally of little value. Potent topical steroid ointments are not effective unless they are applied before the appearance of blisters and continued for 2 to 3 weeks, so are not recommended. Alcohol applications are painful and do not hasten resolution of the rash. There are new topical agents, such as pimecrolimus (Elidel) 1% cream and tacrolimus (Protopic) 0.03% or 0.1% ointment, which modulate the immune system and are effective without causing skin atrophy, as would be caused by a superpotent topical steroid.

If the reaction is severe (facial or genital involvement or intolerable itching), the victim should be treated with a course of oral prednisone (80 to 100 mg each of the first 3 days, then decreased by 10 mg every 2 days until the final dose is 10 mg—80, 80, 70, 70, 60, 60, and so on). Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh. At the end of the course of corticosteroids, the victim may suffer a "flare-up" of the rash and symptoms, which may be treated with a repeated course of medication.

Once the resin has been removed from the skin, the rash and blister fluid are not contagious. However, if the resin is still present, touching the involved skin will allow resin to be transferred to other areas. All clothes, sleeping bags, and pets should be washed with soap and water, because the resin can persist for years, particularly on woolen garments and blankets.

For prevention, there are few commercially available topical chemical preparations that act as effective barriers, although it appears that activated charcoal, aluminum oxide, and silica gel may work. Multi Shield (Interpro) is a protective agent for sensitive individuals. It should be applied over any sunscreen, and must be washed off carefully after use according to instructions. Stokogard Outdoor Cream is a linoleic acid dimer barrier cream preparation that is advertised to provide up to 8 hours of skin protection. Hollister Moisture Barrier and Hydropel may prove useful as barriers. IvyBlock (Enviro-derm Pharmaceuticals) contains bentoquatam, which acts as a barrier. It is applied at least 15 minutes before going outdoors and then every 4 hours. Antiperspirants are used anecdotally as barriers, but have not been proven effective.

Other Irritating Plants

Some plants produce fluids or crystals that act as primary irritants to the skin, in a nonallergic reaction. These plants include buttercup, croton bush, spurge, manchineel, beach apple, daisy, mustard, radish, pineapple, lemon, crown of thorns, milkbush, candelabra cactus, daffodil, hyacinth, stinging nettle, itchweed, dogwood, barley, millet, prickly pear, snow-on-the-mountain, primrose, geranium, meadow rue, narcissus, oleander, opuntia cactus, mesquite, tulip, mistletoe, wolfsbane, and horse nettle.

The skin should be thoroughly washed with soap and water. If barbs are embedded in the skin, removal may be easiest if you apply the sticky side of adhesive tape to the skin, and then peel the barbs off with the tape.

Small cactus spines can be removed by applying the sticky side of adhesive (duct) tape and peeling it off, or spreading a facial gel (mask or peel) or rubber cement, allowing it to dry, and peeling it off. Large spines can be removed with forceps, which may be necessary if the barbs on the cactus spine inhibit easy removal with the adhesive-tape method. A single cactus thorn can be as sharp as a needle and penetrate easily through the skin without leaving an external mark.

Medicated soaks recommended by dermatologists for plant-induced skin irritation include aluminum acetate solution (1:20) or Dalibour (Dalidane) solution (copper and zinc sulfate and camphor). Administration of corticosteroids (such as prednisone) is not useful for a primary (nonallergic) skin irritation.

RASHES INCURRED IN THE WATER

Seaweed Dermatitis

There are more than 3,000 species of alga, which range in size from 1 micron to 100 meters in length. The blue-green algae *Microcoleus lyngbyaceus* is a fine, hair-like plant that gets inside the bathing suit of the unwary aquanaut in Hawaiian and Floridian waters, particularly during summer months. Usually, skin under the suit remains in moist contact with the algae (the other skin dries or is rinsed off) and becomes red and itchy, with occasional blistering and/or weeping. The reaction may start a few minutes to a few hours after the victim leaves the water. Treatment consists of a vigorous soap-and-water scrub, followed by a rinse with isopropyl (rubbing) alcohol. Apply hydrocortisone lotion 1% twice a day. If the reaction is severe, oral prednisone may be administered in a dose similar to that for a severe poison oak reaction (see page 234).

Swimmer's Itch

Swimmer's itch (clamdigger's itch) is caused by skin contact with cercariae, which are the immature free-swimming larval forms of parasitic schistosomes (flatworms) found throughout the world in both fresh and salt waters. Snails and

birds are the intermediate hosts for the flatworms; the worms do not colonize humans. They release hundreds of fork-tailed microscopic cercariae into the water.

The affliction is contracted when a film of cercaria-infested water dries on exposed (uncovered by clothing) skin. As the water begins to dry, the cercariae penetrate the outer layer of the skin, but die immediately. An allergic response causes itching to be noted within minutes. Each schistosome that enters the skin causes a single red raised spot. Shortly afterward, the skin can become diffusely reddened and swollen, with an intense rash and, occasionally, hives. Blisters may develop over the next 24 to 48 hours. If the area is scratched, it may become infected and the victim develop impetigo (see page 239). Untreated, the affliction is limited to 1 to 2 weeks. Those who have suffered swimmer's itch previously may be more severely affected on repeated exposures, which suggests that an allergy might be present.

Swimmer's itch can be prevented by briskly rubbing the skin with a towel immediately after leaving the water, to prevent the cercariae from having time to penetrate the skin. Once the reaction has occurred, the skin should be lightly rinsed with isopropyl (rubbing) alcohol and then coated with calamine or Caladryl lotion. Additional remedies are baking soda or anti-itch oatmeal tub baths. If the reaction is severe, the victim should be treated with oral prednisone as if he suffered from poison oak (see page 234).

Because the cercariae are present in greatest concentration in shallow, warmer water and in weed beds (where the snails are), swimmers should seek to avoid these areas.

Sea Bather's Eruption

Sea bather's eruption, often misnamed sea lice (which are true crustacean parasites on fish), occurs in seawater and often involves bathing suit-covered areas of the skin in addition to exposed areas. The skin rash distribution may be similar to that from seaweed dermatitis, but no seaweed is found on the skin. The cause is stings from the nematocysts (stinging cells) of thimble jellyfish, such as *Linuche unguiculata*, and the larval forms of certain anemones. The victim may notice a tingling sensation on exposed skin or under the bathing suit (breasts, groin, cuffs of wet suits) while still in the water, which is made much worse if he takes a freshwater rinse (shower) while still wearing the suit. The rash usually consists of red bumps, which may become dense and confluent. Itching is severe and may become painful. Treatment is often not optimal, because application of vinegar or rubbing alcohol to stop the envenomation may not be very effective. An agent that may work better is a solution of papain (such as unseasoned meat tenderizer), which may be applied using a mildly abrasive pad. Another remedy that may be effective is lidocaine hydrochloride 4%. After the decontamination and a thorough freshwater rinse, apply hydrocortisone lotion 1% twice a day to treat the inflammatory component of the skin reaction. If the

reaction is severe, the victim may suffer from headache, fever, chills, weakness, vomiting, itchy eyes, and burning on urination, and should be treated with oral prednisone as if he suffered from poison oak (see page 234). Topical calamine lotion with 1% menthol may be soothing.

The stinging cells may remain in the bathing suit even after it dries, so once a person has sustained a sea bather's eruption, his clothing should undergo a machine washing or be thoroughly rinsed in alcohol or vinegar, then be washed by hand with soap and water.

To prevent sea bather's eruption, an ocean bather or diver should wear, at a minimum, a synthetic nylon-rubber (Lycra [DuPont]) "dive skin." Safe Sea Sunblock with Jellyfish Sting Protective Lotion (www.buysafesea.com) is both a sunscreen and jellyfish sting inhibitor that may be used to diminish the incidence and severity of jellyfish stings.

Soapfish Dermatitis

The tropical soapfish *Rypticus saponaceous* (Figure 121) is covered with a soapy mucus. When exposed to this slime, the victim's skin becomes red, itches, and undergoes mild swelling. Treatment involves a thorough wash with soap and water, followed by cool compresses, application of calamine lotion, and treatment for a mild allergic reaction similar to that for hives (see page 238).

Fish Handler's Disease

When cleaning marine fish or shellfish, the handler frequently creates small nicks and scrapes in his skin, usually on his hands. If these become infected with the bacteria *Erysipelothrix rhusiopathiae*, a skin rash may develop within 2 to 7 days. The rash appears as a red to violet-colored area of raised skin surrounding the small cut or scrape, with warmth, slight tenderness, and a well-defined border (Figure 122). The sufferer should be treated with penicillin, cephalexin, or ciprofloxacin for 1 week.



Figure 121. A soapfish enveloped by a cloud of irritant mucus that it secreted.



Figure 122. Typical rash of fish-handler's disease.

Seal Finger

Seal finger is a unique infection, usually of a finger, caused by exposure to seals, walruses, and sea lions. The human victim contacts the skin or a mucous membrane of the animals to initiate the infection, which is characterized by swelling and pain that starts as a small nodule. Swelling and stiffness of the finger progresses to involve the joint, which can lead to bone and cartilage damage. Treatment is with oral tetracycline. The initial dose is 1.5 g, followed by 500 mg four times a day for 4 to 6 weeks.

HIVES

Hives are one skin manifestation of an allergic reaction, or may develop as part of a nonallergic reaction (such as to a medication). Hives appear as raised, red, and irregularly bordered welts or thickened patches of skin (Figure 123). Often, the victim will also complain of itching and/or fever. The treatment for hives presumed to be caused by allergy is to administer an antihistamine (such as diphenhydramine [Benadryl]) at 6-hour intervals until the rash has begun to subside and the itching is relieved, and to observe the victim closely for progression to a serious allergic reaction. Hives can appear in moments, yet take days to completely resolve. If the victim complains of shortness of breath or wheezing, or has a swollen tongue (muffled voice) or lips, anticipate a more serious allergic reaction (see page 66). Be prepared to administer epinephrine.



Figure 123. Hives.

Hives can also be induced by exposure to cold or during rewarming of cold skin (cold urticaria). Accompanying the skin lesions can be fatigue, headache, shortness of breath, rapid heart rate, and, rarely, full-blown anaphylaxis (see page 66). Avoidance of cold may not be totally preventive, since the rate of cooling seems to be as important a factor as the environmental temperature. Avoidance of sudden temperature changes and cold exposure are advised. Certain drugs, such as cyproheptadine (Periactin), may be prescribed by a physician as treatment.

Skin-colored swelling (sometimes severe and called angioedema, indicating fluid collection in the deep skin and subcutaneous tissues) of the lips, eyes, and mucous membranes occurs in 2 to 20 per 10,000 new users of angiotensin-converting enzyme (ACE) inhibitors (a type of drug used to treat hypertension). This is also seen with penicillin allergy and may portend difficulty breathing, so should be treated aggressively, as for a severe allergic reaction (see page 66).

HEAT RASH

Heat rash is a skin irritation composed of small raised spots that coalesce to form large areas of redness, particularly in the groin, under the arms, in the creases of the elbows, over the chest, under the neck, and under the breasts. It is rarely itchy; more often, it becomes irritated, particularly with rubbing. It should be treated with cool compresses; with light cotton clothing that will absorb sweat; and, if painful, with thin applications of 0.5% to 1% hydrocortisone lotion twice a day.

INTERTRIGO

Intertrigo is softening and maceration of skin caused by moisture and rubbing where two skin surfaces are in continual close contact, such as in the creases underneath a woman's breasts, in the groin, or in skin folds of obese persons. Attempts to keep the area dry are usually unsuccessful in hot and humid environments. To soothe the rash, apply a thin layer of antiseptic ointment, such as bacitracin or mupirocin. If the rash begins to show a white curdlike discharge, it may be a yeast infection (see page 133) and may respond to an antifungal preparation.

IMPETIGO

Impetigo is a highly contagious, superficial skin infection caused by the bacteria *Staphylococcus*, with or without an antecedent *Streptococcus* infection. It is most often seen in warm and humid climates, and presents as discrete weeping sores,

with honey yellow crusted scabs (with or without yellow pus) of the sort often associated with infected insect bites, small scrapes, or areas frequently scratched. The rash may start as pinhead-sized blisters filled with white or yellow pus. Once a few sores have become infected and ruptured, they coalesce and crop up all over the body (particularly in children), and can cause fevers, fatigue, and swollen regional lymph glands. In the blister form of impetigo, the victim shows large, superficial, and fragile blisters that are commonly seen on the trunk, limbs, armpits, and other skinfold areas.

The skin should be washed twice a day with pHisoHex (not for infants and children under 2 years of age) scrub, a half-strength solution of hydrogen peroxide, or soap and water, and the sores covered with a thin layer of mupirocin ointment or cream, bacitracin (less effective) ointment, or retapumulin 1% ointment. Before applying the ointment (three times a day until all lesions have cleared), remove the crusts with warm soaks. MRSA-related infections (see below) may be treated with bacitracin (alone or in combination with polymyxin and neomycin), mupirocin, or retapamulin, although topical therapy may not be sufficient to treat the infection. Note that oral antibiotics, in the absence of MRSA, offer no particular benefit over proper topical therapy. If an oral antibiotic is used, treatment involves the administration of oral dicloxacillin, cephalexin, azithromycin, erythromycin, or amoxicillin/clavulanate for 7 to 10 days. If there is resistance to these antibiotics or a high concern for methicillin-resistant *Staphylococcus aureus* (MRSA), use trimethoprim-sulfamethoxazole (particularly for children under 8 years old), doxycycline, or minocycline (the latter two are contraindicated in children younger than 8 years).

If a person is prone to impetigo, he may be a chronic carrier of *Staphylococcus* bacteria inside his nose. This can be controlled for up to 3 months by an intranasal application, using a cotton-tipped swab, of mupirocin calcium ointment 2% (Bactroban Nasal) four times a day for 5 days.

CELLULITIS, INCLUDING METHICILLIN-RESISTANT *Staphylococcus aureus* (MRSA)

Cellulitis is inflammation of soft tissues of the body, commonly involving the skin and subcutaneous (under the skin) structures. Signs and symptoms include reddened skin, swelling, tenderness, blistering and “weeping” from the skin (in severe cases), tender and swollen lymph nodes, and fever and chills (severe cases). It is often caused by the bacteria *Streptococcus* or *Staphylococcus*. Many other germs can cause cellulitis, particularly if it follows a dog bite, injury in the aquatic environment, scratch from a thorn or plant, or if the victim suffers from immunosuppression.

An increasing cause of cellulitis is methicillin-resistant *Staphylococcus aureus* (MRSA), which can generate prolonged and debilitating infections. These bacteria are resistant to all currently available penicillins and cephalosporins. If MRSA infection is a possibility, the antibiotics of choice in the outdoors are trimethoprim-sulfamethoxazole, doxycycline, or clindamycin. (Other drugs that may be prescribed

by a physician once the diagnosis is confirmed include daptomycin, linezolid, or rifampin, the latter as part of a combination therapy.) The disadvantages of clindamycin are its association with subsequent diarrhea caused by *Clostridium difficile* and the emergence of bacterial resistance. If trimethoprim-sulfamethoxazole or a tetracycline is prescribed because of suspicion for a MRSA infection, it is prudent to add a beta-lactam (such as cephalexin) antibiotic to cover possible infection with group A streptococci. Trimethoprim-sulfamethoxazole used alone for MRSA has met with mixed results. Doxycycline and minocycline should not be considered to be automatically effective substitutes for tetracycline. Rifampin is sometimes used in combination with trimethoprim-sulfamethoxazole or doxycycline to treat MRSA infection, but this is not based on scientific data. Fluoroquinolone antibiotics, such as ciprofloxacin (Cipro), should not be used to treat skin and soft-tissue infections caused by community-acquired MRSA, because of bacterial resistance. High-risk persons for MRSA infection include contacts of a person with a MRSA infection, children, male homosexuals, soldiers, prisoners, athletes (especially in contact sports), Native Americans, Pacific Islanders, previously infected individuals, and intravenous drug users. If MRSA is not a consideration (unfortunately, this will increasingly be less the case), antibiotics for cellulitis may include cephalexin, dicloxacillin, or amoxicillin-clavulanate.

If cellulitis is associated with human or animal bite (see page 409), the initial antibiotic should be amoxicillin-clavulanate; if it is associated with exposure to fresh water or salt water (see page 354), ciprofloxacin or doxycycline should be administered along with an antibiotic to cover *Staphylococcus*; if it is associated with exposure to raw meat, fish or clam processing, or animal handling, infection with *Erysipelothrix rhusiopathiae* ("fish handler's disease"), should be suspected and the initial antibiotic treatment should include amoxicillin or ciprofloxacin.

Important measures to prevent the spread of any skin infection, and in particular MRSA infection, include covering all draining wounds with clean bandages, washing hands after contact with a contaminated wound, laundering clothing after it has been contaminated, bathing regularly using soap, avoiding sharing items (such as towels, clothing, razors, etc.) that may be contaminated, and cleaning equipment with effective agents (such as detergent or disinfectant, such as a quaternary ammonium compound or dilute bleach).

ABSCESS

An abscess (boil) is a collection of pus. Although it can occur anywhere on or in the body, it is most frequently noticed on the skin, particularly in an area of high perspiration, friction, and bacteria (particularly *Staphylococcus*) accumulation, such as associated with hair follicles under the arm (Figure 124) or in the groin. The early abscess first appears as a firm, tender red lump, which progresses over the course of a few days into a reddish-purple, soft, tender, raised area, occasionally with a white or yellowish cap ("comes to a head") (Figure 125). The surrounding skin is reddened and thickened, and regional lymph glands may be

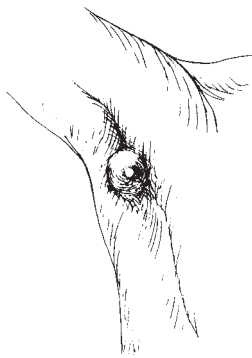


Figure 124. External appearance of an abscess in the armpit.



Figure 125. Cross section of a pus pocket, with a soft cap.

swollen and tender. Fever, swollen lymph glands, and red streaking that travels in a linear fashion from the infected site toward the trunk indicate the spread of infection into the lymphatic system (Figure 126).

Treatment involves drainage of the pus and dead tissue from within the core of the soft abscess. This is performed by taking a sharp blade and cutting a line into the roof of the abscess at its softest point (Figure 127). The incision must be large enough (generally, at least half the size of the soft area) to allow all of the pus to run out. On rare occasion, the pus inside the abscess will squirt from the incision, so take care to protect your eyes and clothes. After the pus is allowed to drain, the cavity should be rinsed well and then packed snugly with a small piece of gauze to prevent the skin from sealing closed over the created empty space (and thus merely reaccumulating pus, rather than healing). Each day, the packing is removed (yank it out quickly to minimize pain), and the wound irrigated and then repacked until the cavity shrinks to a small size. If the abscess remains open while it is healing such that continuous drainage is assured, packing is not necessary. If the abscess is adequately drained, there is no need to begin antibiotic administration.

Do not squeeze an abscess to cause rupture, particularly not on the face. This may force bacteria into the bloodstream and create a much more serious infection elsewhere (such as behind the eye or in the brain). After you make an incision into the top of an abscess and it is draining freely, it is all right to push the sides gently to express the pus.

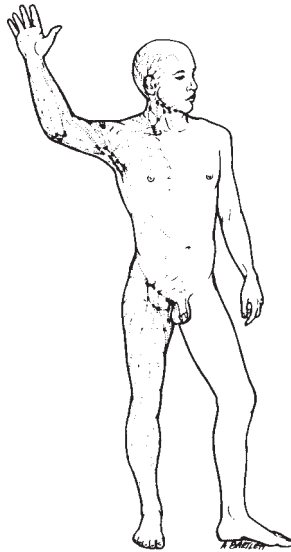


Figure 126. Location of lymph nodes within the lymphatic system. Tenderness and enlargement of the nodes mark inflammation in the lymph nodes; red streaking can sometimes be appreciated.

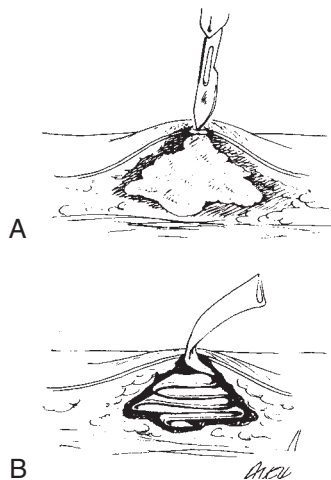


Figure 127. A, To drain an abscess, a stab wound is made in the center of the softest area. **B,** After the pus is removed and the cavity is rinsed, a gauze wick is layered into the cavity.

If the abscess has not yet softened, but is still red, painful, and hard, begin the victim on warm soaks and administer dicloxacillin, erythromycin, or cephalexin. Continue the soaks until the abscess softens and a white or yellow cap becomes apparent. If the abscess is soft, but there is evidence of lymphatic infection (see above), administer an antibiotic.

INGROWN TOENAIL

An ingrown toenail occurs when the lateral edge of a nail penetrates into the skin alongside or outside the groove in which it advances during growth. This can be caused by an injury to the nail or toe, improperly fitting footwear, or improper trimming. Redness, pain, and swelling are common, and an infection may develop.

Treatment involves relieving the pressure created by the toenail on the soft tissues that surround it. Soak the affected toe for 30 minutes in a basin or bucket of warm water, preferably with a squirt of disinfectant such as povidone iodine solution. Using a blunt, stiff tweezer, needle driver (see page 269), scissors, or nail clipper, rotate (extract) the ingrown portion of the nail out of the nail bed, and clip (cut) it off (Figure 128). If this is impossible because of pain, which is common when there is an infection, you may need to first administer pain medication. To prevent the nail from growing back into the groove and once again becoming ingrown, layer (pack) the groove with cotton or strips of gauze or clean cloth. Change the packing every few days until the nail has grown back correctly or you can no longer keep the packing in place.

If you don't have any tools to trim the nail and wish to relieve the pressure, try taking a piece of tape and placing one edge on the soft tissue of the toe against, but not touching, the edge of the ingrown nail (Figure 129). Wrap the tape underneath the toe while pulling, to separate the soft tissue from the nail and relieve the pressure. This is a temporary measure at best.

If there are signs of an infection (see page 240), administer dicloxacillin, cephalexin, or erythromycin for 5 to 7 days and continue the warm- or hot-water soaks two or three times a day.

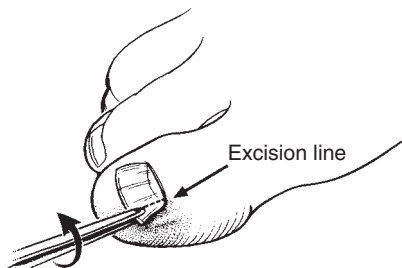


Figure 128. Removing an ingrown toenail.

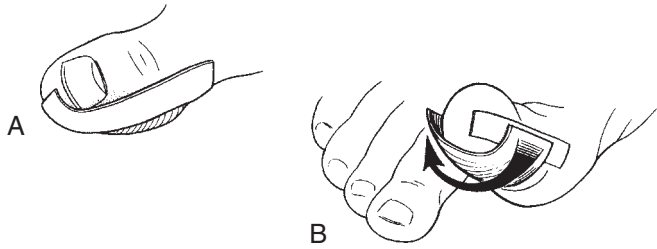


Figure 129. Relieving the pressure on an ingrown toenail. **A**, Place a strip of tape next to the painful ingrown toenail. **B**, Wrap the tape under the toe to separate the tissue from the nail.

FINGERTIP CRACKS

Annoying superficial fingertip skin cracks occur in cold, dry climates or after repeated exposure to saltwater and abrasion. They can be prevented by using skin moisturizers and limiting handwashing. Healing can be accelerated by applying a greasy (petrolatum-based) ointment and covering with a bandage. If the crack is resilient, it can be closed with a small amount of superglue (ethyl-2-cyanoacrylate). Medicinal tissue adhesives that should be used, if available, in preference to ethyl-2-cyanoacrylate are 2-octyl-cyanoacrylate (DERMABOND) or n-2-butylcyanoacrylate (Histoacryl Blue or GluStitch). After you apply the glue and let it set, apply a fingertip bandage to keep the wound dry for 2 to 3 days. As the crack heals, the shed skin carries away the residual glue. If the glue is dislodged by accident before the crack heals, it should be reapplied.

PARONYCHIA

A paronychia is a small abscess (see page 241) at the base of a nail (just beyond the cuticle) in the space between the soft tissue and the nail. It commonly appears as a red or yellowish, soft, and tender swelling in one corner at the base of the nail (Figure 130, A). If the nail feels mobile, there may be an underlying abscess.

If the area is firm, it may not yet be ready for incision and drainage, so begin warm water soaks. To treat a soft or draining paronychia, soak the affected finger in nonscalding hot water with a squirt of disinfectant (such as povidone iodine) for 30 minutes. To drain the collection of pus, you need to slide the tip of a #11 scalpel blade or an 18-gauge needle underneath the cuticle, holding the blade flat against the nail, to puncture the pocket and allow drainage (Figure 130, B). If you don't have a scalpel, you can use a clean, small knife blade, or even the prong of a fork. Lift the tissue gently off the nail. The abscess will be no more than $\frac{1}{4}$ in (0.6 cm) below the margin of the cuticle; if you have penetrated that far without the obvious release of pus, cease your digging, start the victim on dicloxacillin, cephalixin, amoxicillin-clavulanate, or erythromycin, and continue

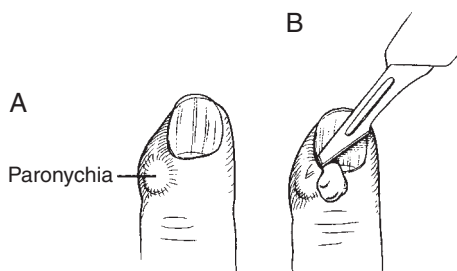


Figure 130. A, Paronychia. B, Draining a paronychia.

with hot-water soaks three times a day. If pus is released, jam a 1 in (2.5 cm) wick of gauze into the pocket, if the victim will tolerate it; with or without the wick, continue the soaks for a few days to keep the pocket draining.

FELON

A felon is a severe infection (abscess) of the pulpy tip of a finger (Figure 131, A), usually caused by infection with *Staphylococcus* or *Streptococcus* bacteria. It can arise from a nick in the skin, extension of a paronychia, infected hangnail, or puncture wound. The finger becomes swollen and extremely tender, with throbbing pain. Occasionally, there is extension of the infection via the lymphatic system (see page 243), with swollen lymph glands behind the elbow and in the armpit. It is possible to develop a fever with a felon.

Merely soaking the felon in hot water will not help much. The definitive treatment is drainage, but this can be extremely painful. An incision needs to be made that allows extensive drainage from the fingertip. This is usually performed by a physician as a single longitudinal incision through the pad of the fingertip, from the side of the finger into the depth of the pad, completely through the finger with placement of a gauze or rubber “drain,” or by flaying the fingertip pad down from the bony tip of the finger (“fish-mouth incision”) (Figure 131, B and C). Following the incision, warm water soaks are undertaken and

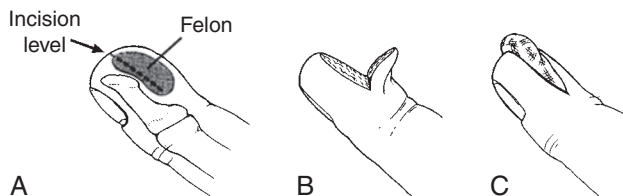


Figure 131. A, Felon. B, Fish-mouth incision for drainage of a felon. C, Packing a small wad of gauze in the incision site to allow drainage.

antibiotics administered. The victim should be started on dicloxacillin, cephalexin, amoxicillin-clavulanate, or erythromycin.

BLISTERS

Blisters are the bane of hikers. These clear fluid- or blood-filled vesicles have probably ended more outings than all major illnesses combined. The cause of a friction blister is the repeated action of skin rubbing against another surface. As the external contact, such as a coarse, sweat- and dust-impregnated sock, moves across the skin, the opposing force is called the frictional force (F_f). The combination of the magnitude of the F_f and the frequency of the rubbing of the object across the skin determines the probability of blister development. Therefore, the greater the F_f , the lower the number of rubbing cycles needed for blister development. In terms of foot blister formation, shear forces extend horizontally between skin layers, between the skin and sock interface, between socks, and between socks and footwear. When the forces within a shoe or boot overcome resistance, sliding occurs. Repeated sliding at a friction point causes an initial sensation of heat—the so-called “hot spot.” Further friction on a hot spot causes blister formation. The separated space in the area under the blister roof quickly fills with fluid. Thick skin like that found on the palms and soles is more likely to undergo blister formation.

Spontaneous blister healing is rapid if one can reduce further friction and worsening of the injury. In a mere 24 hours after blister formation, there is regenerative growth in the blister wound, and at 48 hours, evidence of healing. However, in the presence of continued friction and pressure, as is often the case in the backcountry, the body benefits from medical attention that provides healing assistance.

The best protection for a blister is its own roof. Small intact blisters that are not causing significant discomfort should be left intact (Figure 132). To assist in protecting this roof, a small adhesive bandage or pad can be applied. Be certain to place a first layer of paper tape under any cloth adhesive tape, so you do not inadvertently de-roof the blister when removing the tape.

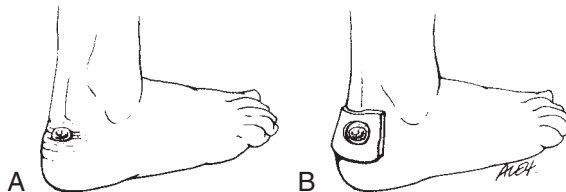


Figure 132. A, Blister on the heel. B, A cushion of moleskin protects the area from further irritation.

The pain from a blister is due to pressure on the incompressible fluid trapped between skin layers. As the abrasion and pressure builds, there is further weakening and separation of skin layers and increased potential for rupturing the blister. When a blister opens, raw skin is exposed. If a blister is punctured with a needle and drained, it will often refill within a few hours. If a large hole is made that allows continuous fluid drainage, there is risk for tearing off the roof and leaving a large damaged area.

Blisters deep to a callus should not be drained, as this is a painful and difficult process. These subcallus blisters quickly refill with fluid after drainage, and the process can introduce bacteria that cause infection. Likewise, blood-filled blisters should be left intact, because of a similar concern for infection.

Any blister with murky fluid, that is draining pus, or that is associated with warm, red skin or red streaking toward the heart may be infected. If the blister appears to be infected, it should be unroofed entirely, an appropriate dressing applied, and the victim treated with dicloxacillin, erythromycin, or cephalexin for 5 days or until the skin appears normal. If the dressing (such as Curad Hydro Heal) keeps the blister slightly moist, it may be less prone to drying out and cracking.

If a blister is caused by a thermal burn, it should be immediately immersed in cold water (do not apply ice directly to the burn) for 10 to 15 minutes, to relieve pain and lessen the ultimate injury. Then dry the wound and apply a soft, sterile dressing. Unless there is a reason to suspect infection (cloudy fluid or pus, fever, redness and swelling beyond the blister edges, swollen lymph glands), burn blisters should be left intact (see page 108). Opening an uninfected blister or sticking a needle into it risks introducing bacteria that can cause an infection. Topical antibacterial creams such as silver sulfadiazine or mupirocin, or ointments such as mupirocin or bacitracin, should be applied if the blister is broken, or to prevent the dressing from sticking to the wound. Alternatively, apply a layer of Spenco 2nd Skin or Aquaphor gauze underneath a sterile gauze dressing.

There is no one correct way to manage a blister. For every technique and product mentioned, there are at least several different options. The following blister treatments assume that you must continue on your feet, because resting and staying off your feet is not an option.

Basic Blister Treatment (for Intact Blisters)

1. Cut moleskin (or a basic blister care product) into a donut of diameter $\frac{1}{4}$ inch to $\frac{1}{2}$ inch around the blister. The blister should fit inside the hole in the donut.
2. Place a patch of Spenco 2nd Skin in the donut hole directly over the blister.
3. Cover the moleskin donut with another layer of moleskin and patch with benzoin and tape.

Note that this “traditional” moleskin/donut treatment may cause further pressure points either directly under the moleskin or by transferring pressure and subsequent increased friction to the opposite side of the foot.

Basic Blister Draining

1. Cleanse both the blister skin and a safety pin with an alcohol pad (the diameter of a safety pin is larger than that of a sewing needle to allow continuous drainage, yet not so large as to risk de-roofing the blister). If alcohol is not available, you may disinfect the needle by heating it to red hot and then allowing it to cool before use.
2. Puncture the blister with the pin at several points at the margin of the blister (generally on the outside of the foot), rather than via one large hole. This will allow natural foot pressure to continually squeeze out fluid, limiting the risk of de-roofing the blister.
3. Gently push out fluid with your fingers.
4. Blot away the expressed fluid.
5. Cover the drained blister with paper tape (protects the blister roof from being torn away when any other overlying tape is removed).
6. Cover the paper tape with benzoin, and then with shaped adhesive tape. All tape should have trimmed and rounded edges to minimize “dog ears” and peeling off.
7. Reaccumulated fluid can be drained through an intact bandage.

Treatment of Open and Torn Blisters

1. Using small scissors or another sharp object, carefully de-roof the blister, completely trimming off the dead skin.
2. Place Spenco 2nd Skin on raw skin.
3. Cover the Spenco 2nd Skin with paper tape.
4. Apply a benzoin coating.
5. Cover with Elastikon or another tape product.

Toe Blister

1. Drain the blister with an alcohol-cleansed safety pin.
2. Use one piece of Micropore tape to encircle the toe (leaving the torn tape end at the top of the foot to avoid irritating neighboring toes).
3. Pinch the tape closed.
4. Trim sharp edges or wrinkles in the tape. Avoid cloth tape or Elastikon on the toes, as the abrasive nature of these tape varieties may cause blisters on adjacent toes.

To Prevent Blisters

1. Minimize friction generated by the normal biomechanical forces of walking and the contributors to friction. Reduce the carried load, whether that means losing personal weight or shedding pounds from the backpack. Use a padded insole or arch support to help evenly distribute pressure over the bottom surface of the foot.
2. Increase or decrease the ease with which two surfaces rub against each other.
3. Shoes or boots should fit properly and comfortably. Shoes that are too tight increase contact points of pressure on the foot. Those that are too loose allow excess movement that allows generation of friction. Overly narrow shoes typically cause blisters on the large and small toes. Loose shoes can create blisters on the tips of toes from sliding and jamming the tips into the toe box. A toe box that is too shallow can cause blisters on the tops of the toes.
4. Fit (size) shoes in the evening, because feet tend to swell throughout the day. When trying on shoes or boots, make sure to wear the same socks and/or insoles or orthotics that you will be using on the trails. Size boots to compensate for thicker socks.
5. Allow for ample time to break in new footwear. This will stretch the material, sometimes loosen it, and increase flexibility. The breaking-in period also conditions the skin itself by causing the outermost layer to thicken.
6. Soft and supple feet are better able to withstand frictional stress than are cracked and horny feet. Many podiatrists recommend preparing feet with Bag Balm, a moisturizer, petrolatum, or other softening agent. Calluses should be filed down and toenails kept trimmed short and beveled downward.
7. Create a weak shear layer using two pairs of socks. The goal is to have friction occur between the two layers of socks, not between the skin and the socks. Wear a smooth, thin, snug-fitting synthetic sock worn as an inner layer with a thick, woven sock worn as an outer layer. The thinner synthetic liner sock will also assist in moisture control by wicking moisture and perspiration away from the skin surface.
8. Barriers are best utilized as preventive measures before blisters form, either at the beginning of the day or as soon as a hot spot develops. The barrier needs to be adhesive so it can remain fixed to skin, despite the action of friction, warmth, and/or moisture. Blist-O-Ban bandages (SAM Medical Products), Micropore paper tape, cloth tape, Elastikon elastic tape, moleskin, Spenco Blister Pads, Band-Aid Blister Block, and duct tape are methods to prevent blister development. Using an adhesive such as tincture of benzoin or Pedi-Pre Tape Spray will help keep the barrier adherent to the skin.
9. A cardinal rule of taping is to smooth out any wrinkles, and cut off “dog ears” that may lead to further pressure points. ENGO Blister Prevention Patches are slick fabric-film composite patches that are placed on the inside of the shoe or insole. Silicon gel toecaps and sheaths reduce friction between the toes.

10. Keep the skin clean and dry to minimize friction. Skin hydration leads to increasing contact area and friction, so moist skin results in more frequent blisters. However, very wet skin has a low incidence of blister formation, likely due to the lubricating effects of water on the skin surface. High-technology oversocks combine waterproof materials with traditional socks to help keep feet dry when repeatedly exposed to water. Combining GORE-TEX oversocks with wicking liner socks and foot antiperspirant is a method to reduce foot moisture. If your feet are often moist or sweaty, change socks frequently.
11. Consider the addition of gaiters to help eliminate dirt, gravel, sand, and rocks from entering the sock-shoe system.
12. Drying powders decrease moisture for short periods of time and are useful in the evening to dry out feet, but after about 1 hour may actually increase the friction between surfaces. Lubricants have been developed that are more advanced than traditional Vaseline, which is greasy and tends to trap grit particles, which are irritating and may increase friction and blister production. Advanced lubricants that combine silicone and petrolatum have a silky feel, prevent friction, and repel moisture from the skin. Lubricants can be applied preemptively, or over tape when hot spots develop. However, after about 3 hours, friction is increased as the lubricants are absorbed into the skin and socks. Lubricants should be tested before use on the trail to assess for allergic reaction, and if used, reapplied frequently.
13. Antiperspirants irritate and block sweat ducts, reducing the amount of perspiration. People who suffer from a condition called hyperhidrosis experience excessive foot perspiration and subsequently have extremely moist feet. These people may benefit the most from antiperspirants.
14. Blisters or reddened skin may also be caused by an allergic ("contact") reaction to chemicals such as formaldehyde or rubber. If a rash is confined to the soles of the feet (shoe inserts) or top of the feet (shoe tongue dye), suspect this problem. In this case, the footgear must be changed.

ATHLETE'S FOOT, RINGWORM, AND JOCK ITCH

Athlete's foot, ringworm, and jock itch are all caused by fungal infections. These more commonly develop in warm, moist areas, such as between the toes and in the groin. Athlete's foot (tinea pedis, or "foot") can be recognized as a red rash, moist or scaling, with small blisters and frequent weeping. Itching is the major symptom. Ringworm (tinea corporis, or "body") appears as one or more ring-shaped red areas on the torso. The rash spreads outward in an enlarging circle; the central area may clear slightly as the fungus in the center dies. There is scaling and itching, and occasionally tiny blisters at the expanding margin. Jock itch (tinea cruris, or "groin") is a red rash with a well-demarcated border that causes itching and irritation in the groin and occasionally over the genitals.

These rashes are more common in summer, particularly among those who do a lot of sweating and bathe infrequently. They are managed with antifungal cream (terbinafine 1% [Lamisil], butenafine [Lotrimin Ultra], ketoconazole 2% [Nizoral], econazole [Spectazole], or miconazole [Micatin or Lotrimin AF]) and antifungal powder, such as tolnaftate (Tinactin) or clotrimazole 1% (Lotrimin), applied two or three times a day. If the rash is refractory to topical therapy, a physician can prescribe an oral antifungal agent. Because a fungal infection is contagious, socks and underwear should not be shared. If possible, wear cotton underclothing that absorbs sweat.

TINEA VERSICOLOR

Tinea versicolor (sometimes called pityriasis versicolor) is a superficial infection caused by yeasts of the *Malassezia* species that creates skin discoloration with minimal itching or scaling. It appears as multiple discolored (white, gray, pink, or darkened [like a tan]) spots or patches on the shoulders, arms, chest, and back. It is treated with topical applications of selenium sulfide (Selsun) solution for 15 minutes a day for 10 days. Another way to apply Selsun is to moisten the affected area at bedtime, allow it to dry, and then wash it off in the morning. If that is ineffective, it may be treated with topical antifungal preparations (see above) or an oral dose of ketoconazole (Nizoral) 400 mg prescribed by a dermatologist. Alternatively, it can be treated with itraconazole (Sporanox) 800 to 1,000 mg daily for 5 days.

ONYCHOMYCOSIS

Onychomycosis is a fungal infection under a nail, most commonly a toenail. This causes the nail to become discolored and deformed. The condition may be associated with chronic fungal infection in the skin, either as an itchy, scaling, or moist rash, or as recurrent blisters between the toes and on the sole of the foot.

Topical medications are not very effective. A physician may prescribe the antifungal medication itraconazole 200 mg twice a day for 1 week per month for 3 consecutive months, or terbinafine 250 mg per day for 3 months. Because these medications can induce side effects—such as headache, liver and gastrointestinal disturbances, and skin rash—and because they may interact adversely with certain drugs (such as terfenadine, cisapride, midazolam, triazolam, cimetidine, and rifampin), their administration should strictly be guided by a physician. Topical therapies, such as amorolfine, ciclopirox nail lacquer, and tioconazole, may be effective in cases where less than half of the nail is involved.

Prevention involves excellent foot hygiene and avoidance of fungal infection between the toes (athlete's foot) (see page 251). If possible, wash and dry your feet each day. To control foot sweating—which leads to blisters, fungal infections, and foot odor—spray your feet daily with an aluminum chlorhydrate antiperspirant,

unless a fissure or crack appears in the skin, in which case spraying must be discontinued until the skin is healed. An alternative is to use a drying, deodorant foot powder. Each day, gently massage your feet and apply antifungal powder. Keep your nails trimmed. When hiking, use two pairs of socks—an inner thin liner sock of polypropylene or polyester and a thicker outer sock densely woven from a wool (or similar material) blend.

DIAPER RASH

If a baby develops a diaper rash, keep the diaper area clean and dry. For redness alone, apply Desitin diaper cream or A&D ointment. If a fungal infection is suspected, as evidenced by a more intensely red rash, raised bumps, and faint whitish discharge in the groin creases, add an antifungal cream, such as miconazole (Micatin). Do not apply steroid cream or ointment preparations, which can cause an infant's skin to atrophy.

LICE

In a situation of poor hygiene and shared living quarters, particularly overseas, you may acquire head and/or body lice, which make their homes predominantly in hair-covered areas of the body. The overwhelming symptom is itching. To search for head lice, inspect the scalp carefully. On close inspection, you may discover nits (white, ovoid 0.5 to 1 mm empty egg cases) attached to the hair shaft, or tiny 3 to 4 mm adult crawling forms in the scalp, or rarely on the eyelashes. The nits remain attached to the hair, and move out with hair growth at a rate of approximately 0.4 in (1 cm) per month. A common finding is swollen lymph glands behind the ears or running down the back of the neck. Body lice and their nits live in the seams of clothing. The bites are most abundant on the shoulders, trunk, and buttocks. The pubic louse, or “crab” louse, prefers to reside in pubic hair, but may also appear on the eyebrows, on the eyelashes, or under the arms. Bites are hard to find, but if the infestation has been present for a few weeks, peculiar steel gray spots may be seen on the trunk and thighs.

Fortunately, lice cannot leap or fly. It is often difficult to identify lice and mites by simple visual inspection of the scalp. A fine “nit comb” run through the scalp is better for detection. Wetting the hair may help. The treatment is to lather the body and scalp vigorously with crotamiton 10% (Eurax) lotion, leave the lather in place for 10 minutes, and then rinse. For pubic lice, it may be necessary to rub crotamiton lotion into the affected area daily for several weeks to destroy hatching ova.

For head lice, children may be treated with 5% permethrin (Elimite) cream in a single application; this is safe for infants over 2 months of age. Rub the cream into the skin and scalp, and wash it off after 8 to 12 hours. Comb the hair thoroughly in a direction toward the scalp to remove all nits. To be most effective, the process should be repeated in 1 week.

One percent permethrin cream rinse (Nix) or 0.5% malathion lotion (Ovide; approved for age 2 years and older) is also effective for removing lice from the hair. Apply it after the hair has been washed and towel-dried, leave it on for 10 to 20 minutes, and then rinse it off. Use a fine-toothed comb to remove the nits after rinsing. Comb again in 1 to 2 days. Repeat the treatment in 7 days to eliminate emerging lice. A treatment for resistant head and body lice is 0.3% pyrethium and 3% piperonyl butoxide (R and C shampoo, or RID) applied to all affected areas and washed off after 10 minutes. Pubic lice may be treated with the same medications used for head lice.

All hats, scarves, clothing, and bedding (including sleeping bags) should be washed thoroughly with laundry soap in hot water or dry-cleaned. All people in close contact should be evaluated for lice and treated if necessary.

Lindane 1% (Kwell) shampoo and other lindane-containing products have been banned in the state of California. Lindane has been shown to damage the liver, kidney, nervous systems, and immune systems of laboratory animals such as rats, mice, and dogs when exposed to high levels during their lifetime. The State Department of Health Services stated that lindane is less effective and has more potential toxicity than the easily available alternatives; therefore, there is no reason to continue prescribing lindane for the control of head lice in California.

SCABIES

Scabies is caused by the human scabies mite *Sarcoptes scabiei* var. *hominis*, which completes its entire life cycle on the skin of a human. It is usually acquired during sexual contact, but can also be acquired from clothing and bedding. The usual manifestations are severe nocturnal itching, which is provoked by body warming, such as occurs from the heat of a fire. A serpentine burrow is seen on the surface of the skin, which is created as an impregnated adult female burrows into the skin and deposits eggs along a path that usually does not exceed $\frac{1}{3}$ to $\frac{1}{2}$ in (5 to 10 mm) in length. Common sites for infestation are the web spaces between fingers, sides of fingers, wrists, elbows, buttocks, feet and ankles, and belt line. Infants may be infested on the scalp and soles of the feet.

Untreated, the disorder can persist indefinitely. Permethrin cream 5% (Elimite) rinsed off after 8 to 14 hours is an effective therapy approved for use in infants over 2 months of age. A cure can be effected with a single 8-hour application of 1% gamma benzene hexachloride (Kwell) lotion or cream, but this product should not be used in children or pregnant women. Another treatment available in Europe is benzyl benzoate 10% or 25% lotion, rinsed off after 24 hours. Yet another approved in Europe is allethrin 0.6% aerosol, rinsed off after 12 hours. Symptoms may persist (up to a month) after the mites have been killed, until the uppermost layer of skin is shed. The chemical should also be applied beneath the fingernails, where mites may be deposited during scratching. Other therapies are crotamiton ointment or cream 10% for 2 consecutive nights (not very effective), or sulfur in petrolatum (5% to 10%) for 3 consecutive nights.

CREeping ERUPTION

Creeping eruption is the common term for cutaneous larva migrans, which is caused by the larvae of hookworms (*Ancylostoma braziliense*) that infest cats and dogs. Humans pick up the larvae on exposure to dirt, particularly moist, sandy soils following a rainfall. The larvae invade the skin, most commonly on the feet, lower legs, hands, and buttocks (from sitting). The larvae tunnel through the top layer of skin, leaving a serpentine, threadlike trail of inflamed (red) tissue, which itches and may be slightly painful. Treatment is with topical thiabendazole four times a day for 2 weeks. If the topical medication is not available, thiabendazole can be administered in an oral form in a dose of 22 mg/kg (2.2 lb) of body weight, not to exceed 1.5 g per dose, twice a day for 2 days. If the rash doesn't completely resolve within 48 hours after therapy, repeat the treatment.

SHINGLES

Shingles is the common name for herpes zoster, a skin eruption with activation often related to stress. Individuals carry the varicella-zoster virus (the same agent that causes chicken pox [varicella] in children) “silently” in nerve roots. On stimulation, usually in an elderly individual or someone with impaired immunity, it causes the outcropping of a series of blisters in patterns that correspond with skin areas served by particular nerve roots originating from the spinal cord (Figure 133). Classically, the victim will have a day or two of unexplained itching or burning pain in the area that is going to break out, and then will notice the onset of the rash, which appears as crops of clear blisters over 3 to 5 days. Symptoms that occur before the appearance of the rash often include headache, aversion to light, and

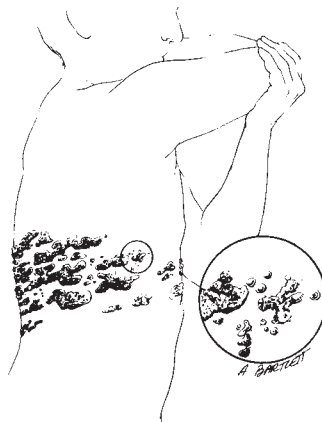


Figure 133. Shingles (herpes zoster) eruption.

fatigue. The discomfort can be tremendous and may necessitate liberal use of pain medication. The rash itself should be kept clean and dry, and covered with a light, dry dressing to prevent further irritation from rubbing or the sun.

The disorder is self-limited, and will resolve spontaneously over the course of approximately 10 days to 4 weeks, as the blisters become cloudy, crust over, and then disappear. If the victim becomes moderately ill (fever, chills, severe headache) or if the rash involves the eyes, mouth, or genitals, see a physician, who may prescribe acyclovir (Zovirax) 800 mg five times a day, valacyclovir (Valtrex) 1 g three times a day, or famciclovir (Famvir) 500 mg three times a day for 5 to 7 days. Unfortunately, after the rash resolves, the pain (“postherpetic neuralgia”) may persist for 1 or 2 months, or even for years. Pregabalin (Lyrica) is a drug that may be prescribed by a physician to treat postherpetic neuralgia.

Zostavax is a new vaccine to reduce the risk for herpes zoster in adults ages 60 years and older. Because it contains live attenuated virus, it should not be given to anyone who is immunosuppressed for any reason. It is given as a single dose subcutaneously. It appears to be quite effective in preventing shingles in persons who have never before suffered from this condition.

HERPES SIMPLEX VIRUS GENITAL INFECTION

Herpes simplex virus 1 infection is associated with lesions on the face and mouth (e.g., fever blisters), whereas herpes simplex virus 2 infection typically causes infection in the genital region (as well as occasionally on the face). After an incubation period of 2 to 10 days from the time of sexual contact, the victim suffers 1 or 2 days of tingling and burning pain precisely where the sores will develop. These skin irritations are painful or itchy, and may be reddened patches of blisters or ulcers. The victim may also suffer headache, fever, muscle and joint aches, and nausea and vomiting. The recommended treatment for a first episode is acyclovir 400 mg by mouth three times a day or 200 mg by mouth five times a day, famciclovir 250 mg by mouth three times a day, or valacyclovir 1 g by mouth twice a day for 7 to 10 days. A recurrent episode is treated for 5 days.

FEVER BLISTERS

See page 197.



MINOR BRUISES AND WOUNDS

BRUISES

A bruise is a collection of blood that develops in soft tissue (muscle, skin, or fat), caused by a direct blow to the body part, a tearing motion (such as a twisted ankle), or spontaneous bleeding (ruptured or leaking blood vessel). With trauma, tiny blood vessels are torn or crushed and leak blood into the tissue, so that it rapidly becomes discolored. Pain and swelling are proportional to the degree of injury. People on anticoagulants (such as Coumadin) and hemophiliacs tend to develop larger bruises; elders and those taking steroid medications tend to bruise easily, often spontaneously.

The immediate (within the first 48 hours) treatment of a bruise is to apply cold compresses or to immerse the injured part in cold water (such as a mountain stream). This decreases the leakage of blood, minimizes swelling, and helps reduce pain. Cold applications should be made for intermittent 10-minute periods until a minimum total application time of 1 hour is attained. Do not apply ice directly to the skin (to avoid frostbite). Rather, wrap the ice in a cloth before application.

If the swelling progresses rapidly (such as with bleeding into the thigh), an elastic bandage can be wrapped snugly to try to limit the swelling. Continue cold applications over the wrap. It is important to keep the wrap loose enough to allow free circulation (fingertips and toes should remain pink and warm; wrist and foot pulses should remain brisk). Elastic wraps are indicated only if pain and swelling will not allow the victim to extricate himself to seek medical attention.

Elevation of the bruised and swollen part above the level of the heart is essential, to allow gravity to keep further swelling to a minimum.

Never attempt to puncture or cut into a bruise to drain it. This is fraught with the risk of uncontrolled bleeding and the introduction of bacteria that cause infection. The exception to this rule is a tense and painful collection of blood under the fingernail (see page 258).

After 48 to 72 hours, the application of moist or dry heat will promote local circulation and resolution of the swelling and discoloration. Heat ointments or liniments are ineffective; they only irritate nerve endings in the outermost layers of the skin and give a false impression of warmth.

People who have prolonged blood-clotting times and/or who have large bruises should avoid products that contain aspirin, which might cause increased bleeding. A hemophiliac who sustains an expanding bruise will likely need to be transfused with a blood-clotting “factor” to promote coagulation; transport to a medical facility should be prompt.

A severe bruise, usually caused by a direct blunt force, can on rare occasion develop into a compartment syndrome (see page 73).

BLACK EYE

A black eye is a darkened blue or purple discoloration in the region around the eye. It can be caused by a direct blow (bruise) or by blood that has settled into the area from a broken nose, skull fracture, or laceration of the eyebrow or forehead. “Raccoon eyes” are black eyes caused by a skull fracture. If a black eye is due to a direct injury (with swelling and pain), first examine the eyeball for injury (see page 182). The skin discoloration may be treated with intermittent cold compresses for 24 hours.

BLOOD UNDER THE FINGERNAIL

When a fingertip is smashed between two objects, there is frequently a rapid blue discoloration of the fingernail, which is caused by a collection of blood underneath the nail. Pain from the pressure may be quite severe. To relieve the pain, it is necessary to create a small hole in the nail directly over the collection of blood, to allow the blood to drain and thus relieve the pressure. This can be done during the first 24 to 48 hours following the injury by heating a paper clip or similar-diameter metal wire to red-hot temperature in a flame (taking care not to burn your fingers while holding the other end of the wire; use a needle-nose pliers, if available) and quickly pressing it through the nail (Figure 134). Another technique is to drill a small hole in the nail by twirling a scalpel blade, sharp knife, or needle. As soon as the nail is penetrated, blood will spurt out, and the pain will be considerably lessened. Before and after the procedure, the finger should be washed carefully. If the procedure was not performed under sterile conditions, administer dicloxacillin, erythromycin, or cephalexin for 3 days.

PUNCTURE WOUNDS

Puncture wounds are most frequently caused by nails, tree branches, fishhooks, and the like. Because they do not drain freely, these wounds carry a high risk for retained bacteria and subsequent infections. A puncture wound should be

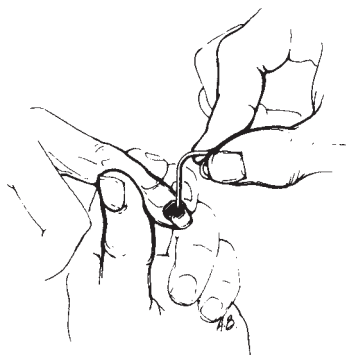


Figure 134. Hot paper clip technique to drain blood from under the fingernail.

irrigated copiously with the cleanest solution that is available and left open to heal. Bleeding washes bacteria from the wound, so a small amount of bleeding should be encouraged. *Never* suture or tape a puncture wound closed, unless necessary to halt profuse bleeding; doing so promotes the development of infection. Similarly, do not occlude the opening of a puncture wound with a “grease seal” or plug of medicinal ointment; apply any antiseptic sparingly. If the wound is more than $\frac{1}{4}$ in (0.6 cm) at its opening, you can leave a piece of sterile gauze in the wound as a wick for a day or two, to allow drainage and prevent the formation of an abscess cavity (see page 241). If the wound becomes infected (see page 240), apply warm soaks four or more times a day. Treat the victim with dicloxacillin, erythromycin, or cephalixin for 4 days.

IMPALED OBJECT

See page 59.

SCRAPES

Scrapes (abrasions) are injuries that occur to the top layers of the skin when it is abraded by a rough surface. They are generally very painful, because large surface areas with numerous nerve endings are involved. Bleeding is of an oozing, rather than free-flowing, nature.

An abrasion should be scrubbed until every last speck of dirt is removed. Although it hurts just to think about this, scrubbing is necessary for two reasons. The first is the infection potential when such a large area of injured skin is exposed to dirt and debris. The second is that if small stones or pieces of dirt are left in the wound, these in essence become like ink in a tattoo, leaving the victim with permanent markings that require surgical excision. Soap-and-water scrubbing with a good final rinse should be followed with an antiseptic ointment such as bacitracin or mupirocin, or cream such as mupirocin, and a sterile nonadherent dressing or Spenco 2nd Skin. You can also place Hydrogel occlusive dressing over an abrasion; it will absorb up to $2\frac{1}{2}$ times its weight in fluid weeping from the wound. It should be covered with a dry, light dressing. This technique is useful for burns as well. If the surface area is not particularly large or is on a difficult-to-bandage area, such as the nose or ears, the bandage (not the ointment) may be omitted.

The pain of cleansing can be relieved by applying pads soaked with lidocaine 2.5% ointment to the abrasion for 10 to 15 minutes before scrubbing. To avoid lidocaine toxicity, don't do this if the surface area of the abrasion exceeds 5% of the total body surface area (an area approximately five times the size of the victim's fingers and palm). In some cases, particularly when there is deeply embedded grime that will be extremely painful to remove, it is useful to inject the wound with a local anesthetic (see page 262).

CUTS (LACERATIONS)

Remove all clothing covering a wound so that you may determine the origin and magnitude of any bleeding.

1. *Control bleeding.* This can be done in almost every instance by direct pressure (see page 54). Apply firm pressure to the wound using a wadded sterile compress, cloth, or direct hand contact (wearing latex gloves, if possible; if you are allergic to latex, use other nonpermeable gloves, such as nonlatex synthetic). Hold the pressure for a full 10 to 15 minutes without release. If this does not stop the bleeding, apply a sterile compress and wrap with an elastic bandage, taking care to not wrap so tightly as to occlude the circulation (check for warm and pink fingers and toes). If bleeding is not controlled with pressure alone, you may need to apply a hemostatic (stops bleeding) dressing or compress. These are described on page 55. During all of these maneuvers, keep the victim calm and elevate the injured part as much as possible.
2. *Clean the wound.* In many cases, “the solution to pollution is dilution.” After you have controlled the bleeding, the minor wound(s) should be properly cleansed. If you have needed to use hemostatic gauze or other ancillary agent (such as Celox) other than brief pressure to control the bleeding, you should wait for at least 60 minutes before attempting to clean the wound. Otherwise, brisk bleeding may reoccur. Wear sterile, nonpermeable, nonlatex gloves if these are available; if you are not allergic to latex, latex gloves are acceptable. If sterile gloves are not available, wear nonsterile gloves. Examine the wound and remove all obvious foreign debris.

The best way to clean a wound is to irrigate away the dirt and bacteria.

The irrigating stream should be forceful enough (approximately 8 to 10 pounds per square inch) to dislodge the foreign material without injuring the tissues beneath the stream or forcing harmful material deeper into the wound. Use the cleanest disinfected water available. The best irrigants are “normal” saline (0.9% NaCl) solution (add 1½ level tsp, or 9 g of table salt, per quart or liter), or a quart of disinfected saline or water. Tap water or disinfected water without the addition of povidone iodine is fine for irrigation purposes. Addition of no more than 1 fluid oz (30 mL) of povidone iodine (Betadine) solution (not soapy “scrub”) into a liter of irrigating fluid has been recommended in the past, but has fallen out of favor. Certainly, don’t use a povidone iodine solution to irrigate eyes, and don’t drink this stuff. Hydrogen peroxide and other antiseptics are also tissue toxic. Try to use at least 500 mL (roughly one pint) of irrigation fluid per wound. There is no benefit from soaking a wound in water, disinfected or not. Soaking may actually increase the bacterial count. If there is grease in the wound, it is best to avoid commercial degreasing agents; use soap and water, followed by water irrigation.

Use a syringe (50 to 60 mL is best, but any size can be used) with a 16- to 20-gauge (18-gauge is best) plastic catheter or steel needle attached to draw up the irrigating fluid and act as a “squirt gun.” This creates a stream of the appropriate force (range of 5 to 12 pounds per square inch). Another way to obtain the appropriate stream diameter and force is to attach a Zerowet Splashield (www.zerowet.com) to a plastic syringe (Figure 135). A complete wound irrigation system (Klenzalac) with a 10 mL syringe, fill stem, and Splashield is also available. This technique protects the operator from splash exposure to blood and tissue fluid. If you don’t have these supplies, you can fill a small (as sturdy as possible) plastic bag with the irrigating solution, punch a tiny hole in the bag, and squeeze out the liquid (Figure 136). Irrigate the wound until it appears clean, usually with at least a pint to a quart ($\frac{1}{2}$ to 1 liter) of liquid. Take care to avoid splashing yourself. Sometimes irrigation isn’t enough to remove all of the dirt from the wound, or you won’t be carrying irrigation equipment. In that case, the wound needs to be scrubbed out with a gauze or cloth, using a disinfectant solution or hand soap and the cleanest disinfected water

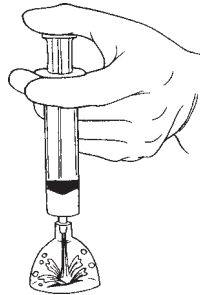


Figure 135. Using a Zerowet Splashield attached to a syringe to irrigate the open wound.



Figure 136. Using a small plastic bag filled with water to irrigate a wound.

available. This can be painful, so get everything ready in advance and then try to accomplish the task as quickly as possible. Rinse the wound thoroughly when you are finished.

Do not forcefully irrigate a puncture wound, because you may push fluid deeper into the tissues, and force germs and other contaminants further into the wound.

Scrubbing and irrigation will often cause a wound to begin bleeding again as blood clots are dislodged from tiny blood vessels. Stop this bleeding by holding absorbent gauze with pressure against the wound.

Do not pour tincture of iodine, rubbing alcohol, merthiolate, mercuriochrome, or any other over-the-counter antiseptic into the wound (except for potentially rabid animal bites—see page 410). These preparations inhibit wound healing and are extremely painful. Although recommended by healers in ancient civilizations, herbal doctors, and professional woodsmen, the use of butter, pine sap, ground charcoal, hard liquor, or wine as an antiseptic is not recommended.

3. *Anesthetize (numb) the wound.* Most laypeople will never be called on to sew (suture) or staple a wound closed. However, for the benefit of rescuers who might need to practice advanced skills, here are the basics:

Local anesthesia of a wound can be achieved by injecting sterile 1% lidocaine or 0.25% bupivacaine solution into the edges of the wound using a 25-, 27-, or 30-gauge needle attached to a 10 mL syringe. There will be less stinging sensation with injection if you add 1 mL of 8.4% sodium bicarbonate solution to each 10 mL of the lidocaine solution before using it. Bicarbonate should not be added to bupivacaine, because it causes precipitation if the solution is not used immediately. Once bicarbonate has been injected, the shelf life of the multidose vial of anesthetic decreases considerably, so this maneuver may not be practical in the field. Whenever possible, use a new ampule or vial of anesthetic for each episode (event, or victim). This minimizes the risk of injecting a contaminated (with bacteria) product and causing a wound infection. *Never* share needles between victims.

To draw up medication into a syringe, follow the instructions given for subcutaneous injection on page 474. The onset of anesthesia from injection of lidocaine or bupivacaine is 2 to 5 minutes, with duration of action 1 hour for lidocaine and 4 hours for bupivacaine. The maximum safe adult dose (volume) of 1% lidocaine is 30 mL; for 0.25% bupivacaine, it is 70 mL. For a child, the maximum safe dose for 1% lidocaine is 0.4 mL/kg (2.2 lb) of body weight, up to 30 mL; the maximum safe dose for 0.25% bupivacaine is 1 mL/kg, up to 70 mL. Of course, it is best to stay as far as possible below the maximum safe dose.

The wound should be cleansed of all major debris and dirt before injecting an anesthetic, so as not to plunge the needle through the grime.

Inject through the open (cut or torn) portion of the wound, rather than

through the surface of the skin, unless this is necessary to avoid gross contamination. One useful technique is to insert the short needle up to its hub, and then inject while you slowly withdraw the needle back out from the skin, rather than injecting during entry. As with any other medical intervention, it is important to have practiced ahead of time before attempting to numb a wound by injecting it with an anesthetic.

Numbing a wound can be done before it is definitively cleansed and irrigated, particularly if the cleansing process will be extremely painful (as when an abrasion needs to be scrubbed). In order to not have to reinject the wound because the anesthetic has worn off, have all of your supplies gathered and your helpers ready to assist before you inject.

Reapproximate the anatomy (close the wound) as best as possible. Most cuts do not involve tissue loss, so that edges fit together like a jigsaw puzzle. Because of the infection risk away from the hospital or doctor's office (a relatively germ-free environment), do not close a wound tightly with stitches of thread (sutures) unless absolutely necessary. Instead, bring the wound edges together with paper tape with adhesive specifically made for wound closure (such as elastic or nonelastic Steri-Strips) or with butterfly bandages (see also page 266 — "Taping a Wound Closed"). The latter can be fashioned from regular surgical adhesive tape (Figure 137). A small scar is preferable to a wound infection caused by tight closure that requires hospitalization for surgical management of a wound infection. If nothing

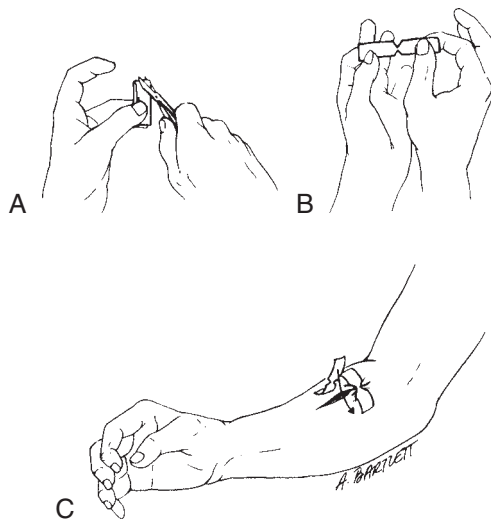


Figure 137. Fashioning a butterfly bandage. **A**, Fold a piece of tape (however, don't let the tape stick together) and cut off both corners at the crease. **B**, The straightened tape reveals the "butterfly." **C**, The bandage is used to hold the wound edges close together.

else is available to hold together the edges of a widely gaping wound that prevents the victim from seeking help, use one or more safety pins.

No matter what method you use to close a wound, the best way to make the opposite sides match up properly, and to take tension off the wound while the remainder of the closure is completed, is to place the first piece of tape, staple, or suture (thread) at the midpoint of the wound ("halve the wound") (Figure 138). The second fastener should then "halve the halves" (Figure 139), so that the wound is now quartered, and so forth until the closure is complete. A final long locking strip can be placed over the ends of the crossing strips to complete the closure (Figure 140).

When aligning the two sides of a cut lip, be sure to match the vermilion border (the line where the skin of the lip meets the skin of the face) perfectly (Figure 141). The same concern holds for aligning a laceration of the eyebrow. Never shave an eyebrow, because it might not grow back! In fact, there is no absolute need to shave hair from the skin around any wound. Shaving hair may increase the risk for infection, because you create micro-nicks in the skin with your razor or knife edge.

Regardless of which technique you choose to close the wound, it is useful to splint the repair (see page 74) for at least a few days, to allow healing to begin without the wear and tear of motion, particularly across a joint.

One way to close a laceration of the scalp is to first lay a long piece of string or dental floss along and beyond the length of the wound (see Figure 37). Next, twirl hair on direct opposite sides of the wound to form strands, and then pull these strands toward each other to pull the skin together. Then, use the string to tie the hair strands together. Repeat this process as necessary to account for the entire open length of the wound. If the wound is large and you do not have any string, you may be able to bring the edges together by tying or gluing together twisted thick strands of hair taken from opposite sides of the wound, but this is often quite difficult (see below).

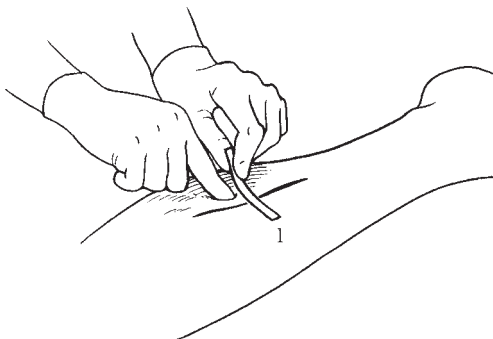


Figure 138. "Halving" a wound for the first act of closure.

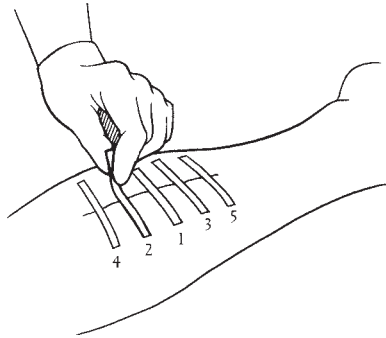


Figure 139. Halving a half, or “quartering the wound.” This helps keep the wound in alignment and prevent mismatched sides (of different lengths).

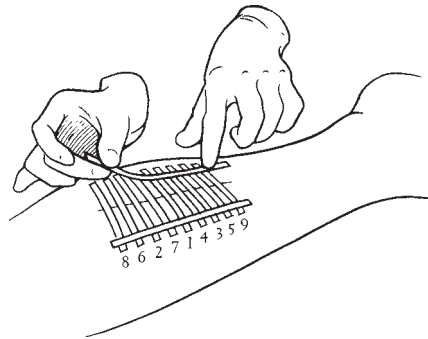


Figure 140. Completed wound closure using tape.

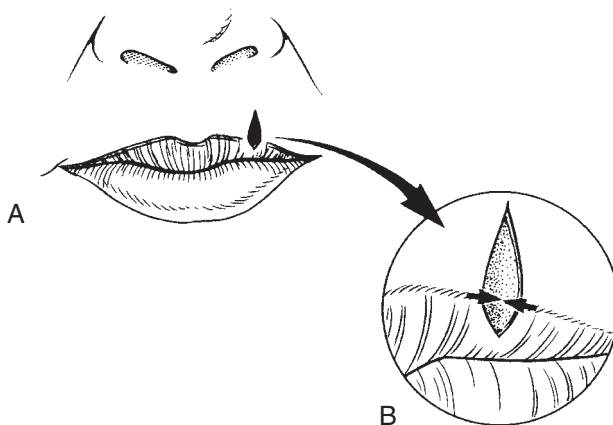


Figure 141. Matching the vermilion border of the lip.

SKIN FLAPS AND AVULSIONS

If a cut occurs at an oblique angle to the skin, so that a very thin layer of skin is “shaved” away, the wound should be cleaned carefully and the flap repositioned and held in place with tape (see below). If the flap is extremely thin or if its base of attachment is small, the blood supply may not be sufficient to allow survival of the tissue. In this circumstance, it will turn dusky blue and then blacken, harden, shrivel, and fall away. Unless there is an underlying infection—in which case the obviously dead or dying tissue should be removed—the flap may provide a biologic covering, much like a skin graft, to allow the underlying tissue to proliferate and heal. Since it is difficult to tell which dusky flaps will survive and turn pink and which will deteriorate and “mummify,” it is best to give the flap at least a few days before trimming to see which way things are headed.

If a large chunk of skin is cut away entirely, or avulsed, the wound must either be closed, allowed to fill in as it heals with new tissue, or covered with a skin graft. The first two options are available to you in the field. If fat or muscle is showing and the wound edges will not easily pull together for field closure, the wound should be cleaned carefully, a sterile bandage (see below) applied, and the victim transported to definitive medical care.

TAPING A WOUND CLOSED

To apply tape to a wound, prepare the skin surrounding the cut by drying it thoroughly. Next, apply a thin layer of tincture of benzoin using a cotton-tipped swab, taking care not to get any into the open wound (it will sting like crazy). Push the two sides of the wound together so that they are perfectly opposed, and then lay the first adhesive strip across the wound at the midpoint of its length. Continue to apply strips perpendicular to the long axis of the wound until it is closed. Use diagonal or crisscross strips for extra strength.

If you don't have an assistant and it is difficult to hold the wound edges together and lay down an adhesive strip at the same time, you can fix a strip to one side of the wound, fix a second strip immediately next to the first one on the opposite side, and then use the two loose ends to pull the wound together (Figure 142). If the strips keep popping off the skin because it is slippery or too much tension is required to keep the edges together, you can run a strip of adhesive tape or duct tape longitudinally along the wound edges on either side of the gash about $\frac{1}{4}$ in (0.6 cm) away from the opening, and use these as anchors for the crossing strips (Figure 143).

Another method of wound closure using tape, which may be more appropriate for a longer wound, is to cut two strips of adhesive tape 1 in (2.5 cm) longer than the wound. Fold one-quarter of each strip of tape over lengthwise (sticky to sticky) to create a long nonsticky edge on each piece (Figure 144). Attach

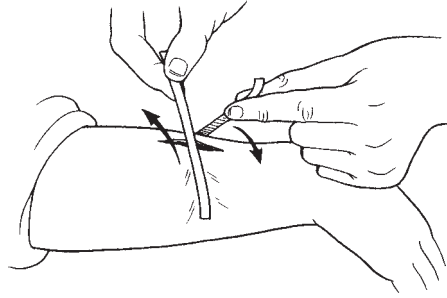


Figure 142. Using opposite-facing tape strips to pull a wound closed.

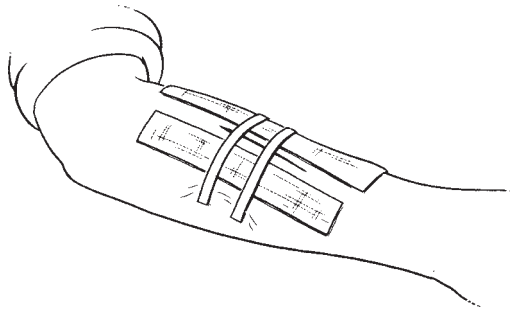


Figure 143. Longitudinal tape strips used as anchors for the cross (closing) pieces.

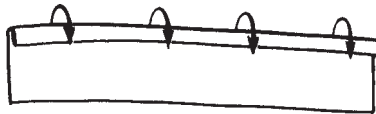


Figure 144. Folding a longitudinal piece of tape to prepare for a suture anchor strip.

one strip of the tape on each side of the wound, $\frac{1}{4}$ in to $\frac{1}{2}$ in (0.6 to 1.3 cm) from the wound, with the folded (nonsticky) edge toward the wound. Using a needle and thread, sew the folded edges together, cinching them tightly enough to bring the wound edges together properly (Figure 145). The tape will stick much better if you first apply a thin layer of benzoin to the skin.

SEWING (SUTURING) A WOUND CLOSED

In general, it is best to avoid sewing (suturing) a wound closed outside of the sterile environment of the hospital. However, sometimes this is necessary, particularly if the wound is large and cannot be closed with taping methods.

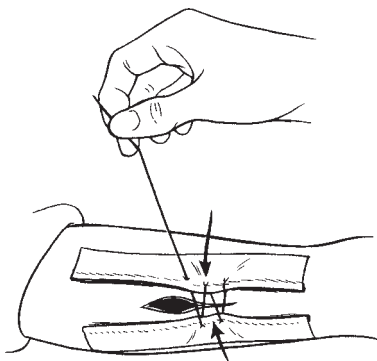


Figure 145. Sewing the tape suture strips together to close the wound.

Sutures come in a variety of sizes attached to many different types of needles, depending on their purpose. For an expedition kit intended for use by a layperson, I recommend carrying 3/O monofilament nylon suture (such as Ethilon, Dermalon, or Prolene) attached (“swaged on”) to a large curved “cutting” needle, and 4/O monofilament nylon suture attached to a large curved cutting needle. The 3/O suture is larger in diameter, and should be used to close large wounds on the scalp, trunk, and limbs. The smaller-diameter 4/O suture is used to close smaller wounds on the trunk, limbs, hands, and feet. Although there are other suture types (such as nonabsorbable silk and absorbable synthetics), sizes (thick to so fine [ophthalmic] that it requires a magnifying glass to see them), and needles (such as small curved, and straight), these two suture setups will suffice for most situations in which a layperson might wish to stitch a wound. Ideally, you would use 5/O and 6/O (smaller diameter) suture material on the face, but this is more difficult to manipulate and tie if you’re inexperienced. The instrument used to push the needle through the skin is a needle holder (Webster-style “needle driver”). It has finger handles like a scissors, and clamps open and shut with finger pressure to hold the needle firmly in its finely grooved jaws. It is held in a certain way to allow the wrist rotation that forces the curved needle through the skin.

The goal of stitching a wound is to bring the skin edges neatly together without excessive tightness, which would be manifested by a wound that is puckered up, and stitches that become buried. Most wounds swell a bit; thus, it is not necessary to cinch them closed with too much tension. After a wound is stitched, it should lie flat.

Wear sterile, nonlatex, nonpermeable surgical gloves if they are available, to avoid a reaction if you are allergic to latex. If you are not allergic to latex, latex gloves may be worn. If sterile gloves are not available, nonsterile gloves are acceptable. The needle should be placed into the jaws of the needle driver so that it can be clamped just behind (toward the suture) the midpoint of the curve (Figure 146). The needle should be oriented

perpendicular to the skin and pushed through using a gentle rotating motion at the wrist; this pushes it out into the base of the wound (Figure 147). Then release the needle, reach down into the wound and regrip the needle that has exited into the wound, and pull the needle and suture through the wound until a 2 in (5 cm) tag is left outside the skin (Figure 148). The needle is once again grasped with the needle driver as before, pushed into the opposite side of the base of the wound at exactly the same depth as it entered into the wound on the other side (Figure 149), and rotated out through the external skin surface on the same side (Figure 150). Now you once again release the needle from the needle driver. The ideal suture placement is square or bottle shaped (Figure 151). As shown in this figure, the suture ideally crosses the wound close to its deepest point; slightly above (see Figures 148 to 151) or below (see Figure 151) is acceptable.

To tie a modified square knot, the long end (with the needle) of the suture is looped around the needle holder twice (Figure 152); then the short end of the suture—which was left as a 2 in (5 cm) tag—is grasped and lock-clamped tightly in the jaws of the needle driver (Figure 153). Holding the needle in one hand and the needle driver in the other, lay the double loop down flat against the skin to pull the wound together (Figure 154). To

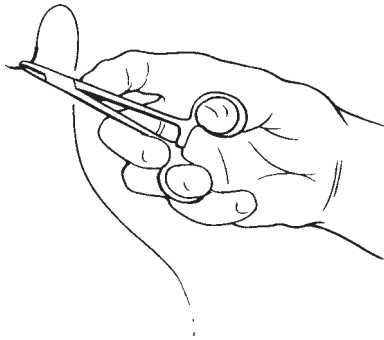


Figure 146. Gripping a suture needle with a needle driver.

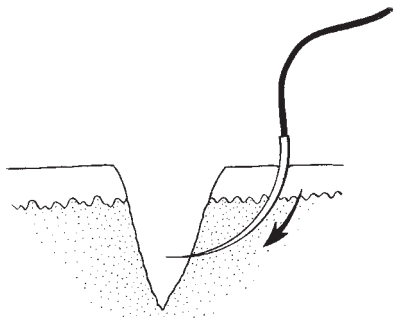


Figure 147. Pushing the needle through the skin and out into the base of the wound.

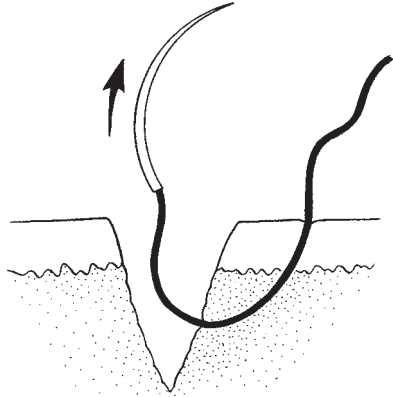


Figure 148. Pulling the suture through the first side of the wound.

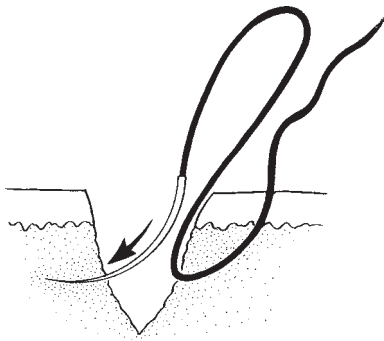


Figure 149. Pushing the needle into the base of the opposite side of the wound.

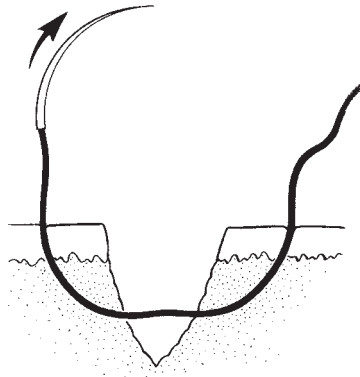


Figure 150. Rotating the needle out through the second (final) side of the wound.

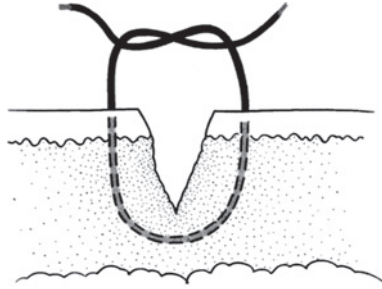


Figure 151. The U shape of proper suture placement.

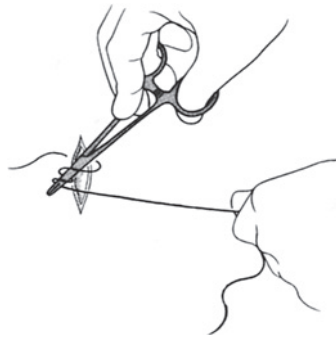


Figure 152. To tie a suture, first loop it around the needle driver twice.



Figure 153. Grab the short end of the suture with the needle driver.

complete the knot, a single loop is thrown around the needle driver in the direction opposite the first (clockwise versus counterclockwise, or “over” versus “under”) (Figure 155), the short end of the suture once again grasped with the needle driver (Figure 156), and the knot pulled tight; cross your hands properly to lay the second loop-tie down flat (“square”) against the first (Figure 157). This process should be repeated three more

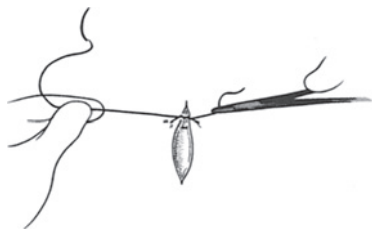


Figure 154. Laying down the first loop of a knot.

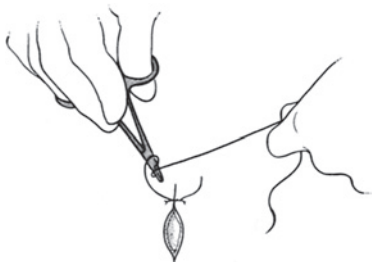


Figure 155. Creating the second loop of a square knot over the needle driver.



Figure 156. Once again, grab the short end of the suture with the needle driver.



Figure 157. Completing the first square knot.

times for a total of five “throws” to ensure that the knot won’t unravel. Cut the long ends $\frac{1}{4}$ in (0.6 cm) from the knot.

Place the stitches close enough together (approximately $\frac{1}{4}$ in [0.6 cm]) so that the wound is closed and there is no fat showing from underneath the skin. A nice way to close a wound is to place enough stitches to bring the wound edges into reasonable approximation and support the tension, and then close the remainder with cloth or paper adhesive strips. Put the first stitch at the midpoint of the wound, then at the midpoints of the remaining segments, and so forth. If you begin stitching at one end and work your way to the other, you run a much greater chance of misaligning the wound edges and ending up with a tear-shaped “dog-ear” that can’t be easily closed; this might force you to remove all of the stitches and begin all over again.

After you stitch a wound, it may ooze blood from the needle holes or the center of the wound. Apply firm, direct pressure with a gauze bandage or cloth for 10 to 15 minutes. To dress the wound, apply a thin layer of bacitracin or mupirocin ointment and an absorbent sterile bandage. Inspect the wound daily for signs of infection (see page 240). If an infection develops, remove a few stitches over the worst area to see if any pus is released. Allowing the wound to drain in one area may allow you to keep the other stitches in place for the normal duration of healing. When in doubt, however, take all of the stitches out and let the wound heal open or under loose approximation with adhesive strips.

Try to keep the wound dry for at least 4 days. Stitches are left in place for 14 days across the joints of the finger and hand, 10 days on the arms and legs, 7 days on the trunk and scalp, and 4 days on the face. After you remove a stitch, you can reinforce a wound with adhesive strips for a week to allow a margin of safety for healing.

If you are going to carry sutures with the intention of sewing a wound, you should have a physician teach you how to suture before you need to do it yourself. You can practice the technique on a pig’s foot, a chicken leg, or even a thick-skinned orange.

To remove a stitch from a healed wound, wash the wound carefully, and then cut the stitch on one side only of the visible knot. (If you cut on both sides of the knot, you may not be able to retrieve the buried portion of the stitch.) Grasp the knot with tweezers and pull the stitch out of the skin. If a crust has formed over the stitch, soften it up by applying moist compresses for 30 minutes before removing it.

STAPLING A WOUND CLOSED

An excellent technique for closing relatively straight lacerations on the arm, leg, trunk, and scalp is stapling. A disposable surgical stapler, such as the Precise 5-, 15-, or 25-staple Disposable Skin Stapler (3M Medical-Surgical Division), allows precise placement of stainless-steel staples. The proper

technique takes practice! Hold the skin edges together and press the business end of the stapler against the wound closure line, and then squeeze the stapler to discharge a staple into the skin (Figure 158). The recipient feels a quick pinprick. The closure is rapid and sturdy. The staples are left in place for 7 days on the scalp and trunk, and 10 days on the arm or leg. A disposable scissors-handle staple remover or smaller pinch-handle-style staple remover (Precise SR-1, 3M) is used to painlessly remove the staples (Figure 159).

If you are going to carry surgical staples with the intention of stapling a wound, you should receive proper instruction before the journey.

GLUING A WOUND CLOSED

Tissue adhesives (“glue”), which can be applied in a thin layer on top of a wound (*not* within the wound) to bond the edges together, have been recommended for superficial cuts. Two examples are 2-octyl-cyanoacrylate

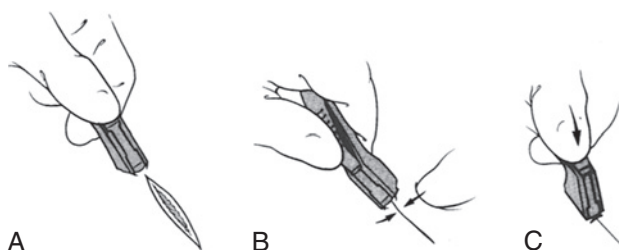


Figure 158. **A**, Preparing to staple a wound. **B**, Pressing the surgical tissue stapler against the skin while pushing the wound edges together. **C**, Squeezing the stapler to discharge the staple into the skin.

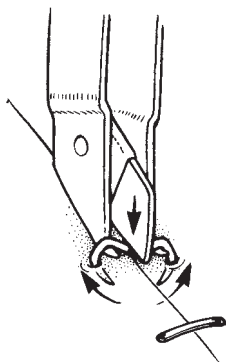


Figure 159. Removing a surgical staple.

(DERMABOND) and n-2-butyl-cyanoacrylate (Histoacryl Blue or GluStitch). The “octyl” tissue glue products are thought to be more flexible than the “butyl” products when dry, but to carry less tensile strength, which is probably not significant for the intended uses. DERMABOND is available in a ProPen applicator that makes this product quite easy to apply. Tissue adhesive wound closure creates a closure that, while not initially absolutely as strong across a highly stressed area, like the skin overlying a finger joint, ultimately results in a similar cosmetic outcome to sewing the skin together. It cannot be used on the eye, inner moist surfaces of the mouth and lips, or areas with dense body hair. Routine tape-strip reinforcement is recommended, and topical ointments should be avoided, as they will weaken the bond between the glue and the skin. After the wound is closed with tissue adhesive, the victim may wash off or shower, but should not soak the wound, swim, or bathe in a tub, because prolonged moisture loosens the bond. Blot, rather than wipe, the area dry. Superglue should not be used to close full-thickness wounds, because it liberates heat when it contacts skin and causes an intense inflammatory reaction.

5. *Dress the wound.* This is generally done in layers. The first layer is antiseptic cream or ointment, which should be sparingly applied to the surface of the wound, provided that there is good drainage and there are no large, open (deep) pockets in the wound. A thick antiseptic grease seal that prevents drainage may actually promote the development of a deep-space infection. Antiseptic ointment may soften and weaken a tissue glue closure. If an antiseptic is not available, honey applied topically on a wound may reduce infection and actually promote wound healing. It is also useful for infected wounds.

A nonadherent next (inner) layer of a bandage keeps the overlying dressing from sticking. This should be nonstick (preferably sterile) Telfa, or an impregnated (with petrolatum, for instance) gauze. If an antiseptic ointment or cream will prevent adhesion of the bandage, a prepackaged square of fine-mesh gauze can be used, but be advised that the ooze from a wound usually negates the lubricating features of most creams, and allows bandages to stick.

Special wound coverings include Spenco 2nd Skin, an inert hydrogel composed of water and polyethylene oxide. It absorbs fluids (so long as it doesn't dry out), which wicks serum and secretions away from the wound and promotes wound healing. Other occlusive hydrogel-type dressings are NU-GEL (preserved polyvinyl pyrrolidone in water) and Hydrogel, which can absorb up to 2½ times its weight in fluids exuded from the wound.

The next layer is composed of absorbent sterile dressings, such as dry gauze pads (see “Bandaging Techniques,” page 276). If these are not available, use clean white cloth (the more absorbent, the better). Apply the entire bandage assembly snugly enough to control bleeding, but not to impede circulation (as judged by warm and pink fingers and toes). Keep dressings

in place with conforming rolled gauze, which can also allow some air circulation. All dressings should be changed as frequently as they become soaked; if there is no significant drainage, they should be changed daily. If the skin is becoming macerated (wrinkled and pale colored; kept perpetually moist), lighten up on the ointment or cream, and apply a less occlusive dressing, while still keeping the wound protected.

Another technique for relatively “dry” wounds (nonseeping and nonbleeding) is to apply a layer of Tegaderm—a thin, semitransparent dressing material through which a wound can “breathe.” This is also available as a small patch packaged with a short (2 $\frac{3}{8}$ in) Steri-Strip in a Wound Closure System (3M). If you use tape to secure a dressing, you can apply tincture of benzoin to increase the stickiness of the skin. Do not let any benzoin run into the wound—it really stings. When dressings are applied, keep the body part in the position of function (normal resting position) (see Figure 39). Check all dressings daily for soaking, a snug fit, and underlying infection. If you wish to remove a dressing that is stuck to a wound, soak it off by moistening it with warm water or a brief application of hydrogen peroxide. Bandaging techniques are addressed in the next section.

6. *Splint the wound* (see page 74). For instance, if the injury involves the hand, also place the arm in a sling to minimize motion of the injured part. Movement delays healing and promotes the spread of infection.
7. *There is always the risk of infection.* If the wound is an animal bite, is of the hand or foot, is a puncture wound, has inadequate drainage, is within the mouth, is deep or complex (e.g., with visible bone or tendon; entering into a joint), is sustained by someone who is immunosuppressed (e.g., human immunodeficiency virus [HIV] infection, diabetes, chronic corticosteroid use), has resulted from a crush injury, or is very dirty (particularly if contaminated with soil)—or if you are more than 24 hours from medical care—the situation carries a high risk for infection and the victim should be treated with an oral antibiotic (dicloxacillin, erythromycin, or cephalexin) until the wound is healed or help is reached. This is also true for any large wound. For a cat (feline) bite, use ciprofloxacin in addition; a physician may substitute cefuroxime or cefoxitin.
8. *Seek appropriate medical attention.* Field cleansing and dressing are no substitute for proper irrigation, trimming, and wound management undertaken in a medical facility. Small nicks do not require fancy intervention, but if you are in doubt as to the seriousness of the injury, get good advice.

BANDAGING TECHNIQUES

Bandage application is an art form. The only way to become proficient is to practice. There is no inviolable rule other than to avoid excessive tightness, which might compromise circulation. Use square knots to tie bandage ends securely.

A triangular bandage is a three-cornered bandage, usually approximately 42 in (1 m) across the base. A cravat is a triangular bandage folded two or three times into a long strap (Figure 160).

The following tips should prove useful:

Finger bandage. Fold a 1 in (2.5 cm) rolled gauze back and forth over the tip of the finger to cover and cushion the wound (Figure 161). Then wrap the gauze around the finger until the bandage is snug and not overly bulky. On the last turn around the finger, pull the gauze over the top of the hand, so that it extends beyond the wrist. Split this tail lengthwise. Tie a knot at the wrist, and wrap the two ends around the wrist; tie again to secure the bandage. Another technique involves not splitting the tail, wrapping it around the wrist twice, and then bringing it up over the top of the hand around

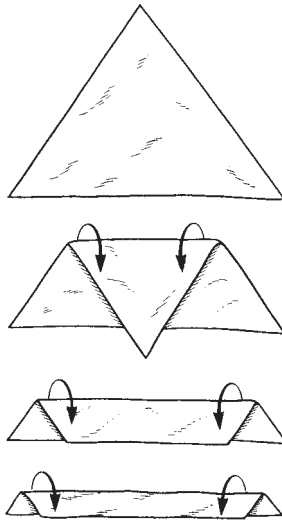


Figure 160. Making a cravat from a triangular bandage.

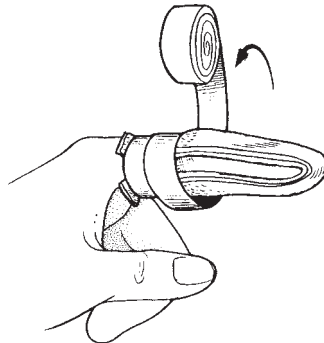


Figure 161. To begin a finger bandage, place layers of gauze over the fingertip.

the base of the finger from the side opposite where it originated, looping it over the hand back to the wrist, and tying it off (Figure 162).

Hand bandage. The hand should be bandaged as if for a fracture, in the position of function (see Figure 39). Take care to place gauze or cotton padding between the fingers to separate and cushion them. Use a simple figure-of-eight wrap across the palm.

Wrist bandage. Begin by wrapping the wrist 2 to 3 times (Figure 163). Continue over the top of the hand, and then through the space between the thumb and fingers, across the palm. Repeat the process in a figure-of-eight pattern until the desired thickness and rigidity is obtained.

Arm or leg bandage. Cover the wound(s) with a gauze pad(s). Overwrap the wound using simple spiral turns of rolled gauze or a figure-of-eight pattern (Figure 164). Secure the bandage with adhesive tape in a spiral pattern to avoid a tourniquet effect. Whenever possible, don't apply tape directly to the skin.

Thigh and groin bandage. Wrap a 6-inch elastic bandage around the mid-thigh in an inner to outer direction and continue up toward the pelvis (Figure 165). At the groin crease, continue up and around the waist one time. This anchors the bandage. Then proceed back down the thigh to complete the figure-of-eight pattern. If the injury is to the quadriceps ("quads") or hamstrings ("hammies") muscles, put additional wraps on the thigh. If the injury is to the groin, alternate wrapping around the hip with wrapping the thigh. Since this is a large bandage, a double-length wrap serves best.

Foot bandage. The foot should be bandaged as if wrapped for an ankle sprain, using gauze instead of elastic wraps (see page 288).

Shoulder bandage. To make a shoulder bandage (Figure 166) from a triangular bandage, lay the base over the shoulder at a downward diagonal across the chest (front and back) with the apex pointed down the arm. Roll or fold

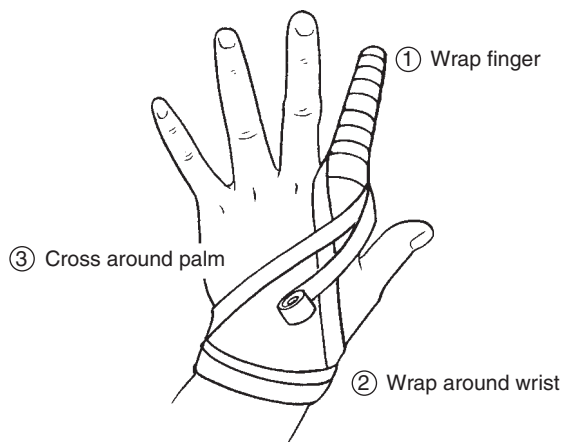


Figure 162. To complete a finger bandage, wrap the gauze around the finger, and then bring it across the palm and around the wrist to tie off.

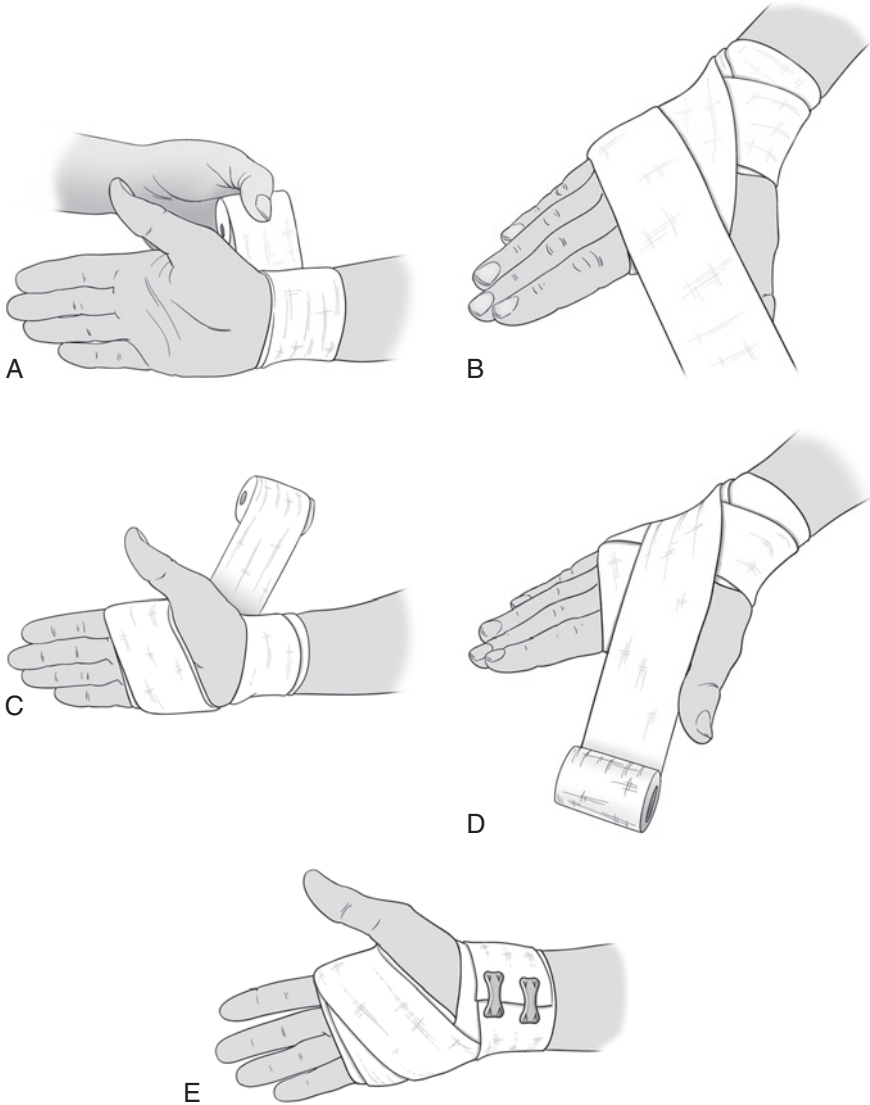


Figure 163. Creation of a wrist bandage. **A**, First, wrap around the wrist a few times. **B**, Continue across the top of the hand and then in the “web space” between the thumb and index finger. **C**, Continue back across the top of the wrist, and then **(D)** continue back over the hand **(E)** in a figure-of-eight pattern. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5], Mosby, 2007, p 436.)

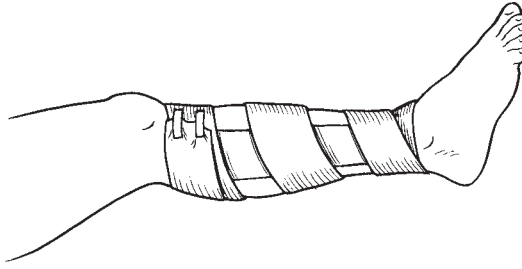


Figure 164. Spiral leg bandage.

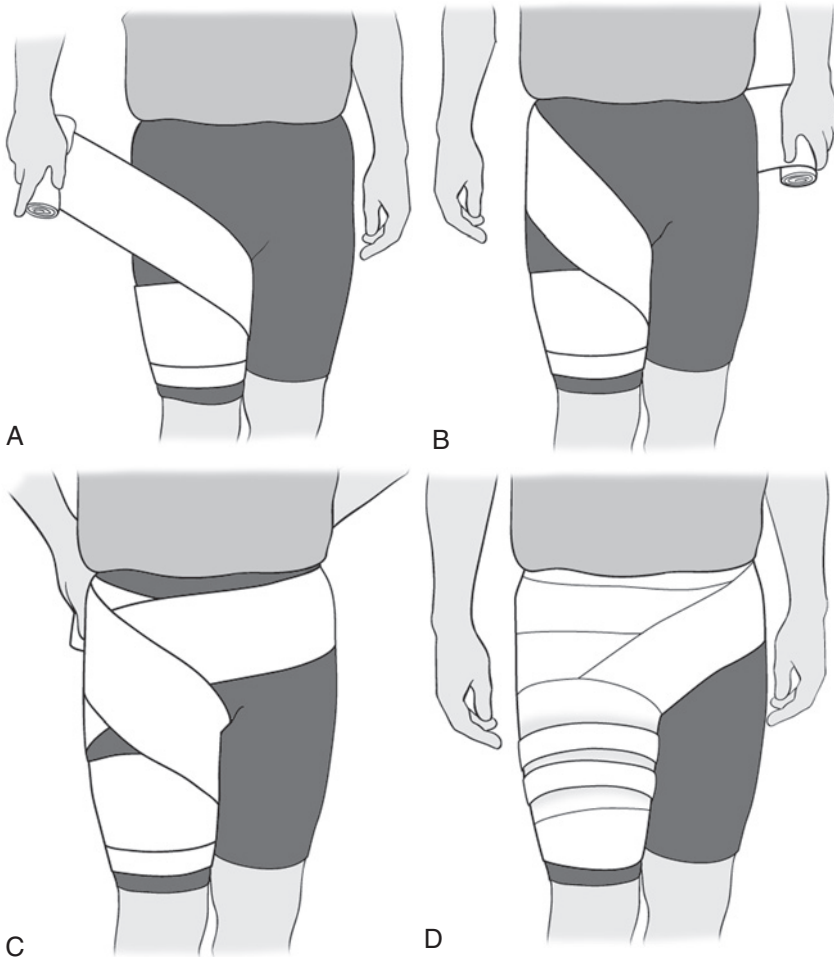


Figure 165. Creation of a thigh and groin bandage. **A**, Wrap a long 6-inch elastic bandage around the midthigh in an inner-to-outer direction, working upward. **B**, At the groin crease, continue to wrap around the waist one time, and then **(C)** wrap back down the thigh. **D**, Finish by wrapping around the thigh. (Redrawn from Auerbach PS [ed]: *Wilderness medicine* [ed 5], Mosby, 2007, p 443.)

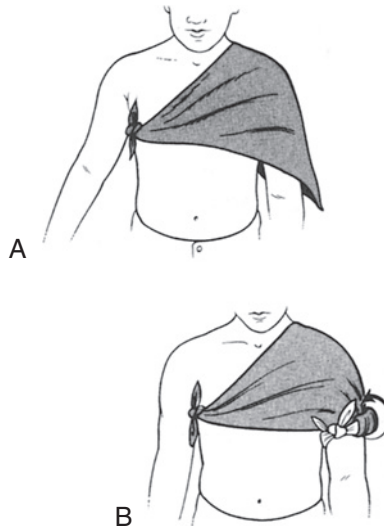


Figure 166. Shoulder bandage. **A**, Drape a triangular bandage over the shoulder. Begin to form a cravat and tie off in front of the opposite armpit. **B**, Complete the bandage.

the apex back down a few turns to create the beginning of a cravat; tie this just in front of the opposite armpit. Roll or fold the apex up the arm in the same manner until the bandage achieves the desired coverage, and then tie off this smaller cravat segment with the knot visible on the outside of the arm.

Chest bandage. To wrap the chest with gauze, circle the chest and upper abdomen for a few turns. To keep the bandage from slipping toward the hips, bring it up over the shoulder every third or fourth turn. Secure with adhesive tape.

Head bandage. Place the base edge of a triangular bandage just over the eyes (Figure 167). Fold the base edge 1 in (2.5 cm) under to create a hem. Allow the bandage to fall back over the top of the head, with the apex point (tail) dropping over the back of the head. Then cross the other two free corners (at the ends of the hem) over the tail and tie them in a single turn (half of a knot). Continue to bring them around to the forehead and tie a complete square knot. Tuck the hanging tail over and into the half knot behind the head. If more pressure is necessary, tie a cravat directly over a gauze or cloth bandage.

Another way to secure a bandage to the side of the head, ear, or chin is to lay a cravat over the wound at the cravat's midpoint, and then wrap it vertically over the head and under the chin (Figure 168). Cross the cravat on the side of the head at ear level, and wrap the ends in opposite directions horizontally so that one side loops across the forehead. Tie the knot behind the ear.

Eye bandage. See page 183.

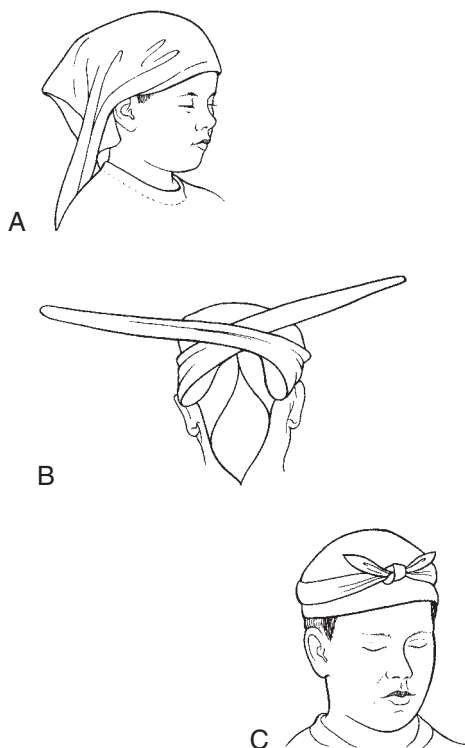


Figure 167. Head bandage. **A**, Drape a triangular bandage just over the eyes. **B**, Create a hem and cross behind the head, tying with a half knot to **(C)** fashion a square knot in the front. Tuck the tail that remains behind the head into the half knot.

WOUND INFECTION

Despite your best efforts, a wound may become infected. The most common bacteria that cause wound infections are *Staphylococcus aureus* and *Streptococcus pyogenes*. The common signs of an infection include redness and swelling surrounding the wound, pus or cloudy discharge (pink, green, or cream colored), a foul odor (this is variable), fever, increased wound tenderness, red streaking that travels to the trunk from the wound, and swollen regional lymph nodes (see Figure 126).

If a wound is infected, its edges should be spread apart to allow the drainage of any pus. To do this, you need to remove some or all fastening bandages (such as butterfly bandages). The wound should then be irrigated copiously and dressed with a dry, absorbent, sterile bandage without bringing the wound edges tightly together. Begin to apply warm, moist compresses, using disinfected water, to the wound at least four times a day; also begin the victim on an antibiotic (dicloxacillin, cephalexin, or erythromycin). For a cat bite, use amoxicillin-clavulanate, cefuroxime axetil, azithromycin, clindamycin plus ciprofloxacin, or penicillin plus dicloxacillin. For a wound incurred in ocean,

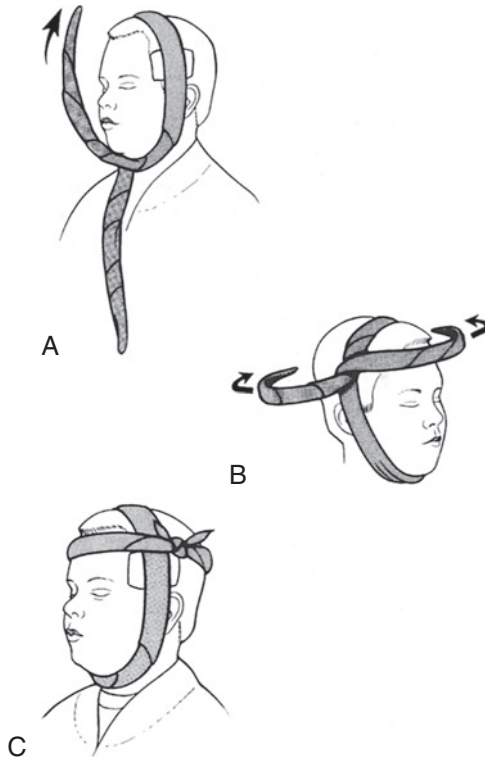


Figure 168. Securing a bandage to the side of the head. **A**, Lay a cravat over the wound. **B**, Cross the cravat and **(C)** tie it off behind the ear.

river, or lake water, administer ciprofloxacin or trimethoprim-sulfamethoxazole as an additional antibiotic.

If a wound infection is advancing, the victim should be brought rapidly to a physician. If you see gas bubbles in a wound, if it is draining foul reddish-gray fluid, and/or if there is a feeling of “Rice Krispies” (crepitus) in the skin surrounding a wound, it may be the onset of gangrene. This is a life-threatening infection and requires immediate advanced surgical attention.

ABSCESS (BOIL)

See page 241.

SCALP LACERATION (CUT ON THE HEAD)

See page 65.

FISHHOOK REMOVAL

See page 476.

SPLINTER REMOVAL

See page 477.

BLISTERS

See page 247.



MUSCULOSKELETAL INJURIES

OVERUSE SYNDROMES

Whenever a muscle is overused—that is, exercised past its state of conditioning—there is actual destruction of the muscle tissue and generation of lactic acid. Given a reasonable rest period, the products of metabolism are carried away in the circulation and the muscle tissue regenerates to a healthy, sometimes even stronger, condition. However, if the exercise has been vigorous and unrelenting, the participant may suffer from a variety of aches and pains that are generally categorized as overuse syndromes.

Carpal Tunnel Syndrome

Carpal tunnel syndrome is caused by elevated pressure in the “carpal tunnel,” which is a space at the base of the wrist through which pass nine tendons that flex (bend toward the palm) the fingers, along with the median nerve. It can be caused for a number of reasons, which include forceful, repetitive use of the wrist. The pressure causes the median nerve to have diminished function,

which leads to the signs and symptoms. These include pain, numbness, tingling, and/or burning sensation on the palm side of the thumb, index finger, middle finger, and thumb side of the fourth finger. The “pinkie” side of the fourth finger and fifth finger are spared, as they are serviced by the ulnar nerve, which lies outside the carpal tunnel. Treatment is to avoid the offending activity and to splint the wrist in a “neutral” position of function (see page 73), both night and day if possible. A nonsteroidal antiinflammatory drug may be helpful. If the case is severe, a physician may prescribe oral steroids or inject steroids into the carpal tunnel. Medical evidence does not support the use of vitamin B₆. If carpal tunnel syndrome persists and the victim shows loss of nerve function or muscle wasting at the base of the thumb, surgery may be advised to decrease the pressure.

Cyclist’s Palsy

If a cyclist leans on the handlebars for an extended period of time, he may compress the ulnar nerve as it passes through the wrist. Symptoms include numbness and tingling of the fifth finger and the outside half of the fourth finger. Treat with a wrist splint and administration of a nonsteroidal antiinflammatory drug, such as ibuprofen. On rare occasion, steroid injection or surgical decompression of the nerve is necessary.

Muscle Fatigue

Simple fatigue, with depletion of energy stores within the muscle, is manifested as weakness, pain on exertion, soreness to the touch, and cramping. In many cases, this is compounded by dehydration, deficiencies of electrolytes (usually sodium and/or potassium), lack of sufficient caloric intake, or a specific injury. The sufferer has been informed by his body that it is time to rest. Sufficient time should be allowed to remove waste products, restore energy sources, correct dehydration, and regenerate muscle tissue. The victim should avoid vigorous physical activity for 12 to 24 hours, and should eat and drink amply. For overuse syndromes, pharmaceutical muscle relaxants are of little value, and pain medication is generally not necessary. Massage of the involved muscle groups is relaxing, although it probably does not hasten recovery.

Shin Splints

Shin splints is the term used to describe a painful disorder generated by excessive walking, running, or hiking. The sufferer has irritated the thin membrane that connects his two lower leg bones along the longitudinal axes where the membrane attaches to the bones. With every footstep, there is further irritation of the

membrane, so that it can become impossible to walk rapidly. The victim should attempt to curtail running or vigorous walking activity, and may benefit from the administration of aspirin or a nonsteroidal antiinflammatory drug (such as ibuprofen or naproxen). A shoe that is well cushioned (particularly its ball and heel) is very important for prevention and recovery. More complex orthotics may be required.

Plantar Fasciitis

Plantar fasciitis is inflammation of the fascia (tough connective sheath tissue) that encloses the muscles and tendons that traverse the bottom of the foot. It is a syndrome of overuse, caused by excessive walking or running, particularly associated with repetitive impact on the bottom of a foot that is improperly cushioned or without appropriate arch support. Symptoms include pain in the bottom of the foot (ball, arch, and/or heel), worsened by repetitive weight bearing. The pain is often worse with the first steps in the morning or after a period of inactivity. It occurs commonly in athletes and long-distance hikers, particularly if they wear poorly fitting shoes or boots. When examining the foot, pain may be elicited by applying pressure to the forward-inside area of the heel.

Treatment consists of rest, elevation of the foot with cold (ice packs) applied to the tender areas at the end of the hiking day, wearing orthotics, gentle stretching (e.g., pulling back the toes and front part of the foot), and administration of an oral nonsteroidal antiinflammatory drug, such as ibuprofen. Worn at night, a splint that holds the foot in neutral position—thus keeping the plantar fascia slightly stretched—may help, as may avoiding walking barefoot or in flat-soled shoes.

If the victim must continue to walk on the painful foot, it can be taped to provide arch support; this can do much to reduce pain. It is accomplished as follows: Apply a thin layer of benzoin or spray tape adhesive onto the bottom of the foot. Fix an anchor strip of $\frac{3}{4}$ in (1.9 cm) adhesive tape in a U shape around the heel from just under the malleoli (prominences of the ankle) up to just behind the level of the “knuckles” of the toes (Figure 169, A). Next, lay fairly tight cross-strips of $\frac{1}{2}$ in (1.3 cm) tape across the bottom of the foot, with their ends torn to lay on the anchor strip (Figure 169, B). This creates a “sling” of tape under the foot for support. Finally, apply another U-shaped piece of tape around the heel that crosses under the center of the arch and locks down the cross-pieces (Figure 169, C).

Torn Muscle

A torn muscle (“pulled” muscle) is recognized as sudden pain in a muscle group associated with a particular vigorous exertion, such as sprinting or lifting a heavy object. Depending on the severity of the injury, there may be associated bruising,

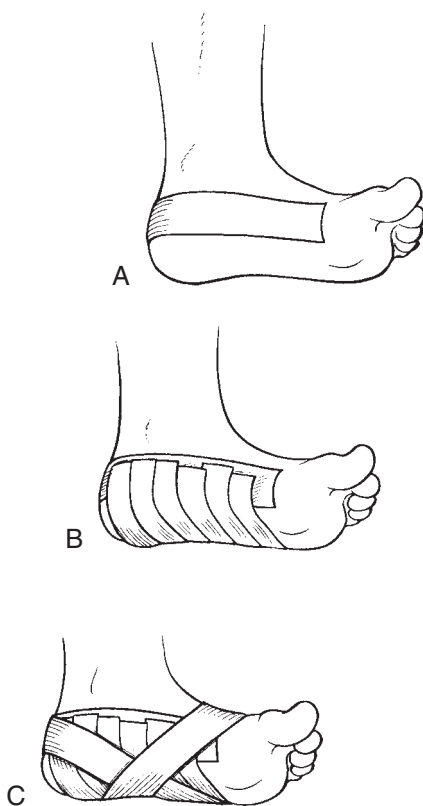


Figure 169. Taping for arch support. **A**, Fix an anchor strip under the heel. **B**, Attach strips across the bottom of the foot. **C**, Lock the crosspieces.

swelling, loss of mobility, and/or weakness. For instance, a small tear in the deltoid muscle of the shoulder may cause minor discomfort on lifting the arm over the head, while a complete separation of the quadriceps group in the anterior thigh will cause inability to straighten the leg at the knee, extreme local pain, blue discoloration of the knee, and a defect in the shape of the muscles above the knee that is easily felt and seen.

In general, a minor muscle injury can be distinguished from a bone injury by evaluating active and passive range of motion. Active range of motion is the range of normal activity the victim can manage without rescuer assistance; this will be painful with both muscle and bone injuries. Passive motion is movement of a body part performed only with the aid of the rescuer; no effort is provided by the victim, who should attempt to relax the muscle completely. If there is no pain on passive (assisted) motion, but pain is present on active motion, the injury is most likely muscular, because an injured bone will hurt no matter how it is moved. If there is pain on passive motion, with or without pain on active motion, suspect a bone injury.

Minor muscle injuries should be treated in the first 24 hours with immobilization, the application of cold (insulated ice packs or chemical cold packs, for example; do not apply ice directly to the skin) for 30 to 45 minutes every 2 to 3 hours, and elevation. After 48 to 72 hours, the application of heat (warm water or a heating pad, *not* ointments) and gentle movement should be started. If a significant injury is suspected (for example, complete tear of the biceps muscle or quadriceps muscle group), the injury should be immobilized as for a fracture (see page 74) and the victim transported to a physician.

The best way to prevent a pulled muscle is to stretch and warm up adequately. This allows the local blood flow to increase and minimizes the risk for small tears that can cause spasm, which in turn leads to decreased flexibility.

Sprains and Strains

Sprains and strains are injuries to ligaments (which attach one bone to another) and tendons (which attach muscle to bone) that are incurred by twisting, direct blunt trauma, or overexertion. Symptoms include pain, swelling and/or deformity, decreased range of motion secondary to pain, and bruising. The treatment is the same as for a suspected fracture. The injured part should be elevated, immobilized (see page 74), and treated with cold applications for the first 24 to 48 hours (“RICE”: rest, ice, compression, and elevation). After 72 hours, heat may be applied. It is important to prevent reinjury (ankles are notorious) by proper wrapping or the application of a splint. Because the injured joint is immediately weakened, it should not be relied on for great exertion.

The most common sprain is of an ankle. If the injury is minor (no chance of a fracture) and/or if the victim needs to put weight on the ankle to seek help, the ankle may be wrapped snugly with an elastic wrap in a figure-of-eight method (Figure 170) or taped in a crisscross weave (Figure 171). During the wrapping or taping, have the victim point his toes and ankle upward by passing a slender rope or strap around the ball of the foot and pulling toward the body (Figure 172). This allows the ankle to be strapped with the foot perpendicular to the leg and the ankle ligaments in the shortened position in which they best heal. A splint can be fashioned from a SAM Splint (see Figures 91 and 92) to provide additional support. If the sprain is severe, splint the ankle as for a fracture. An Aircast Air-Stirrup ankle brace is excellent for in-shoe support.

The Achilles tendon, which runs from the heel into the lower calf, may become irritated or inflamed due to recurrent impact or repetitive stretching, particularly if the heel is not well padded. An inflamed Achilles tendon that is painful should be protected against further irritation by limiting vigorous exercise and using a heel cup or extra padding underneath the heel to reduce stretch forces on the tendon. Achilles tendon rupture is usually caused by a sudden forceful impact on the foot that is “flexed,” with toes pointed down, commonly during a jumping activity. There is pain and a sensation that something has torn or “popped.” The victim has difficulty walking and pushing down with the forefoot. A simple test that can detect

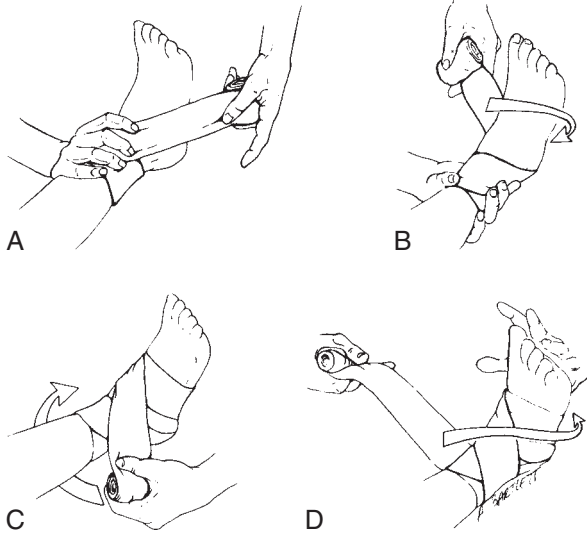


Figure 170. Wrapping the ankle with a figure-of-eight bandage. **A**, Start above the ankle and **(B)** wrap down under the foot. **C**, Cross back and forth over the top of the foot and **(D)** continue in a figure-of-eight pattern to secure the ankle.

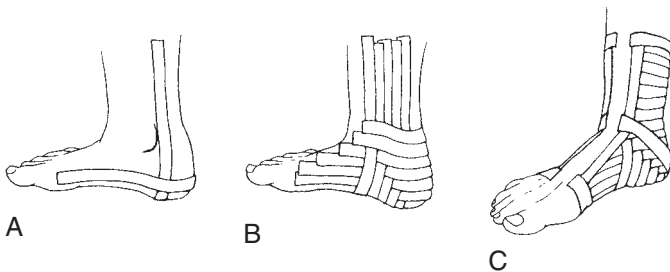


Figure 171. Taping a sprained ankle. **A**, Strips of adhesive tape are placed perpendicular to each other to **(B)** lock the ankle with a tight weave. **C**, The tape edges are covered to prevent peeling.

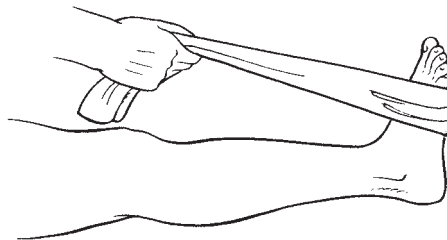


Figure 172. Pulling up on the toes to attain proper ankle position for wrapping.

a complete Achilles tendon rupture is to have the victim lie face down with the leg bent at the knee. Squeeze his calf and see if the foot moves in such a way that the toes point downward. If there is no motion (in comparison to the uninjured side), the tendon may be ruptured. For treatment, splint the foot and ankle with the toes pointed slightly downward, and try to eliminate weight bearing.

Knee sprain is discussed on page 105.

ARTHRITIS

Arthritis is irritation and inflammation of a joint that can be caused by overuse, infection, or various diseases (such as gout, caused by deposition of uric acid crystals). Symptoms include pain in the joint with motion, swelling (fluid collection), redness, and warmth. If there is an infection within the joint, the condition can rapidly become serious. Generally, people with such infections have high fever, shaking chills, weakness, a recent infection elsewhere in the body, or recent direct injury (often penetrating through the skin) to the joint. Differentiating between an arthritic and an infected joint is often impossible until a physician inserts a needle to see if bacterium-laden fluid or pus is present within the joint, and to obtain fluid for a culture. If infection is a possibility, the victim should be started on dicloxacillin, erythromycin, or cephalexin immediately.

If there is little chance of infection and you know the joint problem is due to overuse, have the victim take aspirin or a nonsteroidal antiinflammatory drug, such as ibuprofen or naproxen. Rest the affected joint, keep it elevated if it is swollen, and adjust goals for the trip accordingly. If the victim is known to have gout and experiences an acute flare, he may be treated with prednisone 60 mg by mouth per day, with a tapering dose over a 10-day period.

Glucosamine and chondroitin are dietary supplements taken by some patients who suffer arthritis or overuse syndromes. These are natural substances reputed to repair and maintain cartilage by suppressing inflammation and stimulating cartilage growth, strength, and resilience. The evidence for benefits is mixed, so that most testimonials are anecdotal. These supplements are generally considered to be safe, but can carry side effects of headache, drowsiness, abdominal pain, constipation, diarrhea, heartburn, nausea, skin rash, insulin resistance, and (rarely) allergic reaction.

BURSITIS

Bursitis is irritation and inflammation of the lubricating sac (bursa) that allows muscles to move freely around a joint. Common areas of irritation include the shoulder (irritated by arm swinging), the sac in front of the kneecap (irritated by prolonged kneeling), on the outside of the hip (irritated by walking, hiking, or falling), and behind the elbow (irritated by a fall) (Figure 173). Evaluation and treatment are the same as for arthritis.

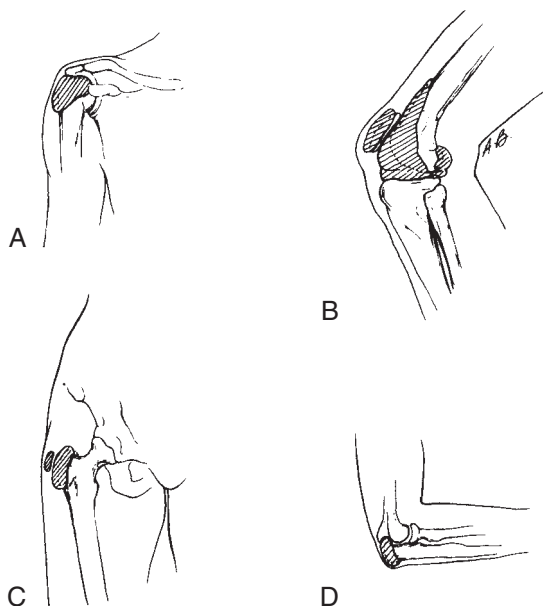


Figure 173. Bursitis affects the lubricating sacs (bursae) near the (A) shoulder, (B) knee, (C) hip, and (D) elbow.

VENOUS THROMBOSIS AND THROMBOPHLEBITIS

Thrombophlebitis is inflammation in a vein associated with the development of a blood clot (known as venous thrombosis: “DVT” means deep venous thrombosis). This occurs in conditions of injury to the veins (cuts, bruises), or after periods of prolonged rest in a single position (sitting on a plane, cramped in a cave); it may also be associated with other risk factors (genetic predisposition, pregnancy, tobacco use, cancer, varicose veins). A blood clot irritates the lining of the vein and causes local redness or purplish discoloration, swelling, warmth, and pain. If the clot enlarges, an entire limb length can become affected. These clots are most common in the lower leg, so the calf muscle may be tender to compression. If the clot is in a deep vein, it may break off and travel to the lungs, where it causes a serious condition known as pulmonary embolism (see page 46).

It is easy to confuse the presentation of thrombophlebitis with that of an infection. If you suspect the former, have the victim elevate the limb and apply hot packs or soaks for 60 minutes every 3 hours. Seek immediate medical attention. If you are more than 24 hours from help and not absolutely certain whether you are treating infection or inflammation, administer an antibiotic (dicloxacillin, erythromycin, or cephalexin).

To avoid venous thrombosis: avoid prolonged periods of inactivity; get up and walk around once an hour when traveling on a plane, bus, or train; remain fit,

active, and well hydrated; consider support hose if you have varicose veins or a history of blood clot formation in your legs or pelvis; and do not use tobacco products.

BACK PAIN

The most common back injury is muscle strain. Symptoms include muscle pain and spasm adjacent to the vertebrae. If these occur in the lumbar (lower-back) region, treatment consists of maximum rest while lying supine on a firm supporting surface. The knees may be drawn up on a pillow or rolled blanket. All possible lifting and forward bending should be discontinued. The victim should take aspirin or a nonsteroidal antiinflammatory drug to control inflammation, and additional pain medicine as necessary. Gentle massage and alternating applications of ice packs and heat are often soothing. For severe muscle spasm, a physician may prescribe a skeletal muscle relaxant, such as metaxalone (Skelaxin) 800 mg by mouth 3 to 4 times per day.

If one of the cushioning intervertebral (between the vertebrae) disks has been injured (Figure 174), additional symptoms may be noted, which include numbness and/or tingling of parts of the leg (indicating impingement of the disk on a nerve root arising from the spinal cord), shooting pains through the buttocks and posterior leg (indicating irritation of the sciatic nerve [sciatica]), leg weakness, foot drop, constipation, or difficulty with urination. The acute treatment is the same as for muscular back strain.

Lumbar spinal stenosis is a condition where there is narrowing of the spinal canal in such a fashion that nerve roots are compressed on exiting the spinal canal. The most common symptom is discomfort that radiates from the back into the buttocks, thigh(s), and lower leg(s), made worse by arching (extending) the back and lessened by bending (flexing) forward. Sitting usually provides relief, whereas walking and hiking worsen the pain. Exercises in which the person leans forward, such as cycling, may be better tolerated. Treatment is with nonsteroidal antiinflammatory drugs. More severe cases require injection of anesthetic into the space immediately outside the spinal cord, or surgery to widen the bony space(s) through which pass the affected nerve root(s).

Backpacks are the quintessential symbol of trekking and mountaineering. A well-fitted, sturdy and durable backpack gives the user the freedom of the hills. Along with hiking boots, a backpack is essential for any sort of expedition in which someone is responsible for carrying his or her supplies. What is less well known is that a poorly fitted backpack can contribute to significant back pain, inefficient travel, or even the ruin of a trip. A backpack that weighs on its carrier can cause muscle spasm, sore neck and shoulders, numbness and tingling in the hands and fingers, sore hips, and irritated skin.

Features in a backpack that will allow it to fit properly, distribute weight evenly and across the correct body parts, and withstand extremes of environment are, in no particular order:

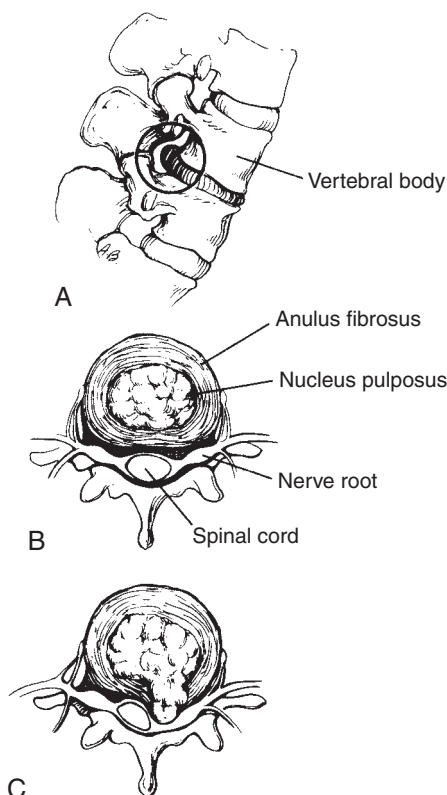


Figure 174. Herniated (slipped) disk. **A**, Posterior protrusion of the disk into the spinal (cord) canal. **B**, Cross section of the normal disk. **C**, Protruding disk impinges on the spinal cord nerve root.

1. Proper size. It fits the torso closely, in particular the upper part of the body. When the padded waist strap is tightened, the weight of the pack should be distributed evenly across the hips.
2. The shoulder straps should be wide and well padded, to avoid compressing the front of the shoulders and armpits. They should be easily loosened and tightened. There should be a connecting strap that can be opened, closed, and adjusted traversing the front of the chest attached to and between the shoulder straps.
3. Adjustable straps to fine-tune the tightness of the waist strap and the proximity of the pack to the back of the wearer are desirable.
4. Multiple compartments allow rational storage, ease of finding carried items, and more even weight distribution than possible with a single-compartment pack. Side pockets, top pockets, tie-down loops, an adjustable top cover, and other features to partition objects into discrete locations while protecting them from the elements are all good to have.

5. The pack should be designed so that it can be donned from a sitting or standing position, using the legs for stabilization. If it can only be put on by hoisting it and slinging it across the back, muscle strain is inevitable.
6. For a child-carrier pack, be certain that it is designed so that an active child can't easily self-extricate the pack and have it wind up dangling or on the ground.



DISORDERS OF THE KIDNEYS, BLADDER, AND PROSTATE

BLADDER INFECTION

Bladder infection (cystitis, sometimes called “urinary tract infection,” or UTI) occurs frequently in females, because the shorter female urethra does not protect the bladder from bacteria as efficiently as does the male organ. A person with a bladder infection complains of discomfort (sharp pain, cramping, or burning) on urination, urge to urinate (“urgency”), frequent urination, difficulty initiating urination, lower abdominal cramping, and sometimes bloody urine, which may be as severe as small clots. Similar symptoms may be suffered by males who harbor infections in the prostate gland.

Treatment involves the administration of an antibiotic and increased oral fluid intake. Because many antibiotics are well concentrated in the urine, there are a number of acceptable treatment regimens. For the sake of simplicity, the female victim may be treated with trimethoprim-sulfamethoxazole (Bactrim or Septra) in one double-strength tablet twice a day for 3 days, or two double-strength tablets in one dose; ciprofloxacin 250 mg twice a day for 3 days, or 500 mg in one dose; ofloxacin 200 mg twice a day for 3 days, or 400 mg in one dose; norfloxacin 400 mg twice a day for 3 days; lomefloxacin 400 mg, trovafloxacin 100 mg, or levofloxacin 250 mg once a day for 3 days; cefpodoxime 100 mg twice a day for 7 days; amoxicillin-clavulanate 500 mg/125 mg twice a day for 7 days; nitrofurantoin monohydrate/macrocrystals (Macrobid) 100 mg capsule twice a day for 7 days with meals; nitrofurantoin macrocrystals 50 to 100 mg four times a day for 7 days; or fosfomycin tromethamine (Monurol) 3 g in a single dose. If the

victim is diabetic or older than 65 years of age, or if the symptoms do not completely resolve or they recur within a few days of therapy, use the same or a different drug for 7 to 10 days. If the victim is pregnant, use amoxicillin, ampicillin, nitrofurantoin, cephalexin, cefadroxil, or trimethoprim-sulfamethoxazole.

Chlamydia are bacterium-like “germs” that are increasingly the cause of reproductive tract infections in women and genitourinary tract infections in men. Because the penicillins (such as ampicillin) are not effective against *Chlamydia*, any male with a bladder infection should be treated with tetracycline (500 mg four times a day), doxycycline (100 mg twice a day), or trimethoprim-sulfamethoxazole (one double-strength tablet twice a day) for 10 days, or with azithromycin 1 g in a single dose. Any male who develops a bladder or prostate infection (see page 297) should be seen by a physician when he returns from his journey.

The incidence of bladder infections in older women may be decreased by a daily 8 oz (237 mL) glass of cranberry juice. It takes several weeks of juice drinking before this effect begins to occur.

It may not be convenient for a woman to squat in order to urinate outdoors. There are devices available to facilitate a woman’s urinating while standing or squatting. The Whiz Freedom is advertised as the world’s first hydrophobic (repels water), antibacterial, and ecofriendly urine director. This device fits over the pudendal region so that urination can be accomplished when standing or sitting outdoors (or indoors) in such a manner that the urine stream is captured and directed away from the body. Another product intended for the same purpose is the “Lady J.”

KIDNEY INFECTION

Kidney infection (pyelonephritis) is considerably more serious than bladder infection. Symptoms may include all of those for bladder infection, as well as flank or lower-back pain, severe abdominal pain, fever, chills, nausea and vomiting, weakness, and cloudy urine with or without a foul odor. The pain is characterized as aching, and may become exquisite if you punch the victim gently just under the ribs adjacent to the spine on the affected side.

The field treatment is the same as for bladder infection, except that the chosen antibiotic must be at a higher dose and continued for at least 14 days. Begin the victim on trimethoprim-sulfamethoxazole (one double-strength tablet twice a day), ciprofloxacin (500 mg once or twice a day), norfloxacin (400 mg twice a day), ofloxacin (200 to 300 mg twice a day), lomefloxacin (400 mg once a day), levofloxacin (250 mg once a day), amoxicillin-clavulanate (875/125 mg twice a day), or cefadroxil (500 mg twice a day). Continue the antibiotics for 10 to 14 days. By definition, the victim is more ill and may require hospitalization for an intravenous antibiotic(s). Therefore, anyone who is suspected to have a kidney infection should be evacuated immediately.

KIDNEY STONE

See page 135.

BLOOD IN THE URINE

Blood in the urine is caused by bladder or kidney infection, the passage of a stone(s), blunt or penetrating injury to the flank (kidney region), bleeding disorder, or tumor of the genitourinary tract. After heavy exertion or high fever, a person may break down a small amount of muscle tissue and release myoglobin (an oxygen-carrying protein found in muscle) into the bloodstream. In cases of burns, severe injury, or certain infections, red blood cells can be destroyed and will release their oxygen-containing protein (hemoglobin) into the bloodstream. Hemoglobin and myoglobin are filtered through the kidneys and may be concentrated in the urine, giving it a pink to reddish-brown hue. If the urine is not made dilute (by drinking large amounts of fluid to increase its volume), the concentration of these pigments in the kidney can clog the filtration system and cause sudden kidney failure. Although after vigorous exercise some individuals may normally pass a small amount of reddish urine, anyone who develops darkened urine after fever or exertion should be placed at maximum rest, cooled to a normal body temperature (see page 322), encouraged to drink as much fluid as possible, and rapidly transported to a medical facility. If you are more than 24 hours away from a doctor, the urine rapidly clears with rest and increased fluids, and the victim appears in good health, the journey may continue.

Urine can also be discolored by the ingestion of chemical agents, such as urinary tract anesthetics (blue-green or orange), beets (pink-red), or bile pigments (brown, seen with hepatitis).

ACUTE URINARY RETENTION

There are rare occasions when a person cannot urinate and the bladder becomes distended with urine. This is seen more often in males than females, because a common cause is obstruction of the urethra where it passes through the male prostate gland. If the gland is enlarged (benign prostatic hypertrophy, or BPH), which occurs in elderly males almost exclusively, the passageway for urine can be narrowed to the point where it becomes obstructed. Early symptoms, which develop as the passage narrows, are difficulty initiating a stream, a weak stream, dribbling (leakage of urine), and urinating small amounts. On occasion, it may become painful to urinate. If the obstruction becomes complete, it causes urine to collect in the bladder, which becomes painfully distended and can be felt as a hard mass in the lower abdomen. Unless the obstruction can be relieved, this is an emergency. The usual treatment is to pass a small tube (catheter) through the penis directly into the bladder. This can be difficult and should only be attempted

by someone trained in the technique. It is a good idea for someone properly trained to carry a urinary catheter(s) and lubricant on any expedition that will include elderly males as participants.

If a male has an enlarged prostate, drugs that are anticholinergic (such as certain antispasmodics) or that contain atropine and its derivatives can precipitate acute urinary retention. For instance, an elderly male with BPH on a diving expedition who takes anti-motion-sickness medication may suffer urinary retention as a side effect of the medication. A medication that relieves the symptoms of BPH in some men is tamsulosin (Flomax 0.4 mg capsule once daily), which relaxes the prostate muscles around the urethra, allowing urine to flow more freely out of the bladder. This medication can create its own side effects of dizziness and low blood pressure on arising, similar to what is seen with dehydration. Therefore, it is important for people using this medication to stay well hydrated and avoid situations in which a dizzy spell or fainting might create a serious injury.

PROSTATE INFECTION

Bacterial infection of the prostate gland (prostatitis) is usually abrupt in onset, with fever, urgency and frequency of urination, pain on urination that may radiate to the lower back, chills, weakness, and sometimes urinary retention. Until the diagnosis is confirmed, the victim should begin to take an oral antibiotic such as ciprofloxacin, ampicillin, or trimethoprim-sulfamethoxazole. On a prolonged journey, if an antibiotic appears to be effective within a few days, it should be continued for a minimum of 3 weeks.



MALE GENITAL PROBLEMS

PAINFUL TESTICLE

If a male complains of a painful testicle, examine both testicles. Look for discoloration or swelling. If a testicle has been injured by a blow, provide support with an improvised jockstrap and apply ice packs. If a testicle suddenly becomes painful, particularly in an adolescent, and appears swollen and/or discolored, usually

without a penile discharge, it may be twisted, or torsed. Since this usually happens if the testicle rotates inward (toward the midline) (Figure 175), gently see if you can rotate it outward within the scrotum. If this causes a dramatic relief of pain, you may have saved the testicle. If the maneuver increases the pain and appears to shorten the “hang” of the testicle, you may be worsening the torsion and might attempt rotating the testicle in the opposite direction.

If you believe an unresolved torsion is present, this is an emergency and the victim should be rushed to a physician. If a torsion is not resolved within the first 4 to 6 hours, the testicle may be lost. The pain is usually followed by swelling in the scrotum and groin region. Sometimes the affected testicle is seen to be slightly higher than the uninvolved testicle. The pain may be of a severity to cause the victim to become nauseated or vomit, and to feel faint.

If a testicle is swollen and the victim complains of pain or burning on urination, he may suffer from an infection or inflammation of the epididymis, which is part of the sperm-collection pathway (Figure 175). Other symptoms include lower abdominal, flank, or groin pain. If the case is severe, the victim may suffer fever, chills, nausea, and muscle aches. This should be treated with doxycycline (100 mg twice a day), tetracycline (500 mg four times a day), levofloxacin (250 mg daily), norfloxacin (400 mg twice a day), or trimethoprim-sulfamethoxazole (one double-strength tablet twice a day) for 10 days.

One way to help distinguish epididymitis from testicular torsion is to gently elevate the scrotum—in general, with epididymitis, the pain is diminished, whereas with torsion it is commonly increased.

PENILE DISCHARGE

If a male complains of a discharge from his penis, particularly if it follows sexual intercourse by a few days and is yellow or greenish in color, you must suspect gonorrhea. In this case, it is safest to treat the victim for both gonorrhea and a chlamydial infection. If more than 24 hours will pass before a doctor can be reached, start the victim on tetracycline 500 mg four times a day or doxycycline

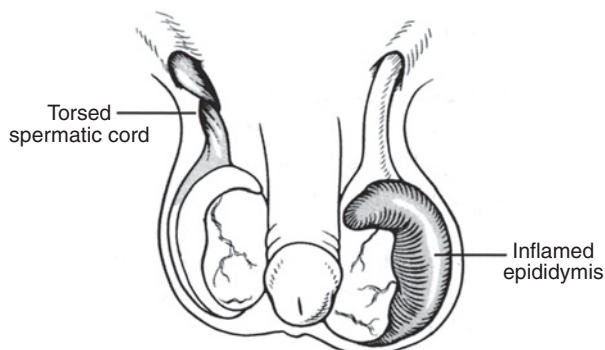
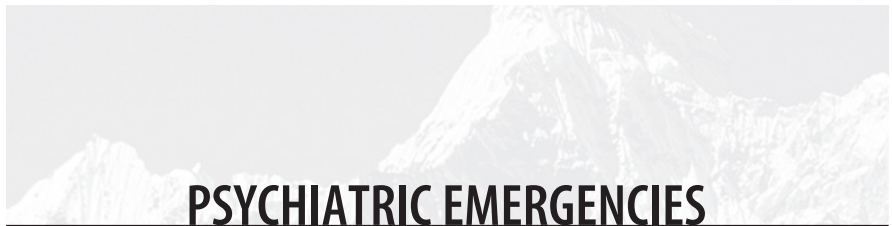


Figure 175. Rotation of the right testicle in a torsion; an inflamed epididymis of the left testicle.

100 mg two times a day for 10 days (to treat *Chlamydia*). Azithromycin 1 g in a single dose is also effective against chlamydial infection. To treat the gonorrhea, administer cefixime 400 mg orally as a single dose. Alternative single-dose therapies for gonorrhea are cefpodoxime 200 mg, cefuroxime 1000 mg, ciprofloxacin 500 mg, ofloxacin 400 mg, azithromycin 2 g, and norfloxacin 800 mg. To treat gonorrhea and chlamydial infection at the same time (the two germs often “travel” together), you can use the one-dose azithromycin therapy. Syphilis may also have been transmitted, so the victim should be tested on return to civilization, even if the victim was treated with a 2 g dose of azithromycin, since there is occasionally resistance of the causative spirochete (*Treponema pallidum*) to azithromycin.

If there has been no sexual intercourse and a penile discharge develops, particularly if it is white or clear, treat with doxycycline or azithromycin.

In this day and age, no person should engage in casual unprotected sexual intercourse. A man should wear a latex (not lambskin) condom that has been stored in a cool, dry place. The package should show no evidence of leakage. The spermicide nonoxynol-9 (condom lubricant or vaginal foam) offers additional protection against viruses.



PSYCHIATRIC EMERGENCIES

The wilderness experience can be quite stressful, and a member of the party may behave in an unusual fashion. This may be directly related to the events at hand or reflect an underlying psychiatric disorder. It is imperative that someone recognize warning signs early and evacuate anyone who cannot retain mental stability, to avoid placing the impaired individual and his traveling companions at risk for injury.

ANXIETY

Anxiety is the most common psychiatric symptom, and may range from appropriate and adaptive minor doubts about success to a full-blown panic reaction. Minor anxiety is expressed as general discomfort about a situation. The excessive worrier may become timid and withdrawn, and may lose his enthusiasm for participation. His anxiety may be clothed in criticism of plans or refusal to

cooperate. It is important that every member of the expedition voice fears and objections at the outset, so as not to be caught in a panic when crossing treacherous terrain or performing rescues.

The treatment is reassurance and support. Frequently, practice sessions that build up to a completed effort will relieve anxiety and improve the performance of the group. In no case should anyone be made to feel ashamed of his fears. Rather, the leader should seek to help the victim conquer them.

Approach what problems you can directly. Most people do much better if fear is identified and managed than if it is never confronted.

In certain circumstances, where anxiety must be conquered to allow extrication, rescue, or even survival, judicious use of an antianxiety drug, such as lorazepam (Ativan) 0.2 to 2 mg, alprazolam (Xanax) 0.5 mg, or diazepam (Valium) 2 to 5 mg may be useful.

PANIC

Panic is anxiety in the extreme. Signs and symptoms may include heart palpitations, sensation of pounding heart, rapid heart rate, sweating, trembling or shaking, shortness of breath or a sensation of “smothering,” choking sensation, chest discomfort, nausea, dizziness, fainting, a sensation of loss of reality, and fear of dying. The victim loses all judgment and becomes consumed with efforts at escape and self-preservation. Panic renders the victim unable to make reasonable decisions and immediately places him and all around him at risk for injury. The rescuer must assume a strong authoritative posture with the panic victim, assuring him in no uncertain terms that the situation is under control and the panic behavior is detrimental. Depending on the situation, this can be done with verbal explanations, convincing arguments, or demonstrations of safety. As for anxiety, antianxiety drugs such as diazepam, lorazepam, or alprazolam may be helpful. If the victim places other individuals at immediate risk for injury, he should be subdued, with force if necessary.

Persons who use cocaine, smoke marijuana or phencyclidine (PCP, angel dust), or ingest LSD are prone to panic reactions under conditions of stress. The management of these reactions is little different from that previously outlined; the exception is the risk of violent behavior from anyone under the influence of cocaine or PCP. If a person appears to be under the influence of psychotropic drugs, do your best to keep him from hurting anyone, but be careful not to become injured yourself in the process.

HYPERVENTILATION

One manifestation of anxiety that verges on panic is the hyperventilation syndrome, in which the victim, overcome by his fears, begins to breathe at an inappropriately rapid rate—40 to 100 times per minute. This causes the level of carbon dioxide in

his blood to fall precipitously and to render the blood alkaline (from its normal neutral state). The symptoms are dizziness; fainting spells; numbness and tingling in the hands, feet, and around the mouth; muscle spasm in the hands and wrists; and, occasionally, seizures. If you are certain that the victim is hyperventilating because of anxiety (that is, there is no reason to suspect a collapsed lung, pneumonia, or other medical problem), place a paper bag or similar device over his mouth and nose for about 5 minutes. The victim breathes in and out of this bag (encourage “slowly and deeply”), and rebreathes his own expired carbon dioxide, allowing normalization of the level in the bloodstream and correction of the symptoms. At the same time, reassure the victim that he will be all right. Always pay close attention, as less oxygen is available to the victim while rebreathing from the bag, so do not use this technique for anyone with heart or lung disease. After the episode, make an attempt to identify the cause of the anxiety.

DEPRESSION

Depression occurs in the outdoor setting in response to situations that are perceived as hopeless. Some victims who are injured, lose their way, or are weakened by starvation and exposure may lose the will to continue. They become listless, fatigued out of proportion to their physical condition, uninterested, inattentive, without appetite, sleepy, and tearful. Clearly, the rescuer must encourage all party members to maintain their survival instincts, to continue to help others and to help themselves. In a cold environment, it is important to remember that hypothermia (see page 305) is a significant cause of apathy and should be corrected, if possible. An individual with chronic depression may go on a vacation trip with the enthusiastic expectation that his psychiatric disease will be alleviated or that his most recent depression has lifted. The sudden realization that such expectations are not fulfilled may put that person at risk for severe mood depression. Do not be afraid to inquire about a past history of psychiatric illness.

REACTION TO AN INJURY OR ILLNESS

People’s reactions to stress differ; they may become irrational, angry, apathetic, confused, or withdrawn following an accident or harsh environmental exposure. The most common reaction, given the presence of a strong leader, is to become dependent. It is crucial for the rescuer to bolster the victim’s self-confidence and self-esteem at every opportunity, for it may take extraordinary physical and mental effort to survive a catastrophe in the wilderness.

Try to individualize your approach to each person. To best understand the changing needs of victims and families, try to maintain regular dialogue intended solely for the purpose of psychological support. Stay with the victim as much as possible. Use frequent touch and reassurances to relay your sense of concern and offer comfort. As best as possible, involve the victim in his

treatment and rescue, so that his thoughts are attuned to survival rather than to fear or grief.

When you are under stress, do your best to be supportive to others with less emotional control. Anger is rarely successful and commonly worsens an already difficult situation.

Equally important, the rescuer must constantly be alert for true medical problems that masquerade as psychological disorders. The uninterested victim may be hypothermic, the belligerent climber hyperthermic, the intoxicated hiker hypoglycemic, or the irritable child stricken with acute mountain sickness.

POSTTRAUMATIC STRESS DISORDER (PTSD)

This is a condition where the victim who has been exposed to an extreme stress or event to which he has responded with fear and helplessness reacts in a manner that includes reexperiencing the event, avoiding reminders of the event, and showing a condition of hyperarousal. Reexperiencing the event can include nightmares or flashbacks; symptoms of avoidance include eliminating any locations, persons, or situations that serve as reminders or showing loss of memory for the event; and hyperarousal means difficulty sleeping, being irritable or short-tempered, having difficulty concentrating, or being exceptionally fearful. Furthermore, a person suffering from PTSD may be having difficulty with activities of daily living, be apathetic, and become fatalistic.

This condition is different from the less complicated responses of fear, grief, anxiety, panic, and even depression. In a wilderness setting, it is more likely to follow a natural disaster with many casualties than one in which there were a small number of victims. Personal pain and violence contribute to the propensity for PTSD, as perhaps do extreme environmental exposures.

Treatment includes habituation that allows confrontation with and understanding of fears, creating an environment of education and support, and stress reduction. In some situations, antidepressant medications are useful, but antianxiety medications may not be very helpful.

PART FOUR

Disorders Related to Specific Environments

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INJURIES AND ILLNESSES DUE TO COLD

HYPOTHERMIA (LOWERED BODY TEMPERATURE)

The body generates heat through metabolic processes that can be maximized with involuntary shivering to roughly 5 times the basal level (up to 10 times with maximum exercise). However, shivering is abolished after a few hours of exposure, because of exhaustion and depletion of muscle energy supplies. When a victim loses the ability to shiver, the cooling process becomes quite rapid. Skin, surface fat, and superficial muscle layers then act as an insulating “shell” for the core of vital organs (heart, lungs, liver, kidneys, and so on). People are tropical beings—that is, when they are naked and at rest, the environmental temperature at which body heat is neither gained nor lost is 82°F (28°C). Normal skin temperature in cool weather is 90°F to 93°F (32.2°C to 33.9°C); this can drop to 70°F to 73°F (21.1°C to 22.8°C) before core cooling begins. Accidental hypothermia occurs when there is an unintentional decrease of 3.6°F (2°C) from the normal core (measured rectally) body temperature of 98.6°F to 99.9°F (37°C to 37.7°C). Normal oral temperature is 98.6°F (37°C). Mild hypothermia is considered to occur when the core temperature is between normal and 91.4°F (33°C); moderate hypothermia is core body temperature below 91.4°F (33°C) down to 85.2°F (29°C); severe hypothermia is core body temperature below 85.2°F (29°C) down to 71.6°F (22°C); and profound hypothermia is below 71.6°F (22°C).

Heat is lost from the body to the environment by direct contact (conduction), air movement (convection), infrared energy emission (radiation), the conversion of liquid (sweat) to a gas (evaporation), and the exhalation of heated air from the lungs (respiration). It is important to note that the rate of heat loss via conduction is increased 5-fold in wet clothes and at least 25-fold in cold-water immersion. Windchill (Figure 176) refers to the increase in the rate of heat loss (convection) that would occur when a victim is exposed to moving air. This chill can be compounded further if the victim is wet (conduction, convection, and evaporation).

At a core body temperature of 96.8°F (36°C), metabolic rate, blood pressure and preshivering muscle tone increase. At 95°F (35°C), the body cannot be any more effective at generating heat by shivering.

Immersion hypothermia refers to the particular case in which a victim has become hypothermic because of sudden immersion into cold water. Again, water has a thermal conductivity approximately 25 times greater than air, and a person immersed in cold water rapidly transfers heat from his skin into the water. The actual rate of core temperature drop in a human is determined in part by these phenomena and in part by how quickly heat is transferred from the core to the skin, skin thickness, the presence or absence of clothing, the initial core

WIND SPEED		TEMPERATURE (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	
5 mph	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63	
10 mph	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72	
15 mph	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77	
20 mph	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81	
25 mph	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84	
30 mph	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87	
35 mph	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89	
40 mph	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91	
45 mph	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93	
50 mph	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95	
55 mph	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97	
60 mph	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98	

Figure 176. Windchill determination. To determine windchill, find the ambient air temperature on the top line, and then read down the column to the line that corresponds with the current wind speed. *Example:* When the air temperature is 10°F and the wind speed is 20 mph, the rate of heat loss is equivalent to -9°F under calm conditions. To convert to metric or Celsius, use the following: 1 mile = 1.61 kilometers; $C = 5/9 (F - 32)$.

temperature, gender, fitness, water temperature, drug effects, nutritional status, and behavior in the water.

A sudden plunge into cold water causes the victim to hyperventilate (see page 300), which may lead to confusion, muscle spasm, and loss of consciousness. The cold water rapidly cools muscles and the victim loses the ability to swim or tread water. Muscles and nerves may become ineffective within 10 minutes. Over the ensuing hour, shivering occurs and then ceases. Anyone pulled from cold water should be presumed to be hypothermic. In terms of survival, the aphorism is that when a person is plunged into very cold water (32°F or 0°C), he or she has 1 minute to control breathing (e.g., to stop hyperventilating from the “gasp reflex”), 10 minutes of purposeful movement before the muscles are numb and not responsive, 1 hour before hypothermia leads to unconsciousness, and 2 hours until profound hypothermia causes death.

The progression of hypothermia leads to predictable physiological responses, which roughly correspond to different body temperatures. Although not invariable, the signs and symptoms are as follows:

91.4°F to 98.6°F (33°C to 37°C). Sensation of cold; shivering; increased heart rate; urge to urinate; slight incoordination in hand movements; increased respiratory rate; increased reflexes (leg jerk when the knee is tapped); red face; muscular incoordination, stumbling gait, maladaptive behavior, rapid heart rate converting to slow heart rate, apathy.

- 85.2°F to 91.4°F (29°C to 33°C). Stupor; decreased or absent shivering; weakness; apathy, drowsiness, and/or confusion; poor judgment; slurred speech; inability to walk or follow commands; paradoxical undressing (inappropriate behavior); complaints of loss of vision; amnesia; rapid heart rate converting to slow heart rate; rapid breathing rate converting to shallow breathing; loss of shivering; possible nonreactive or dilated pupils, abnormal heart rhythms, diminished breathing.
- 71.6°F to 85.2°F (22°C to 29°C). Minimal breathing; coma; decreased respiratory rate; decreased neurologic reflexes progressing to no reflexes; no voluntary motion or response to pain; very slow heart rate, low blood pressure; maximum risk for ventricular fibrillation. The victim no longer can control his body temperature and rapidly cools to the surrounding environmental temperature.
- Below 71.6°F (22°C). Rigid muscles; barely detectable or absent blood pressure, heart rate, and respirations; dilated pupils; risk for ventricular fibrillation; appearance of death.

The first principle of therapy is to suspect hypothermia. Any person who is found in a cold environment should be suspected of suffering from hypothermia. The definition of “cold environment” is variable. Someone who is wet, improperly dressed, and intoxicated with alcohol can become hypothermic in 70°F weather. Do not use yourself as an indicator of warmth—you may be perfectly comfortable while your companion is lapsing into hypothermia.

Unless the victim is found frozen in a block of ice or has been recently pulled from frigid waters, the most likely clue to a hypothermic state is altered mental status. The winter hiker who gradually loses interest and lags behind the group (“Just leave me behind—I’ll catch up”), who dresses inappropriately for the weather or begins to undress, or who begins to stumble and make inappropriate remarks should be immediately evaluated for low body temperature. A hypothermic individual may become anxious, repeat himself, or even become delusional. *Never leave a victim of even mild hypothermia to fend for himself.*

The second principle of therapy is to measure the victim’s temperature. This should be done, if possible, with a thermometer calibrated to read below 94°F (34.4°C), which is the cutoff for most standard oral thermometers. Hypothermia thermometers with a range of 75°F to 105°F (23.9°C to 40.5°C) are available. Temperature ideally should be measured rectally, although this is often impractical. Oral and axillary (armpit) temperatures are unreliable in this situation, and should be used only to screen for low body temperature. That is, if they are normal, the victim will have at least a normal body temperature, but could be hotter. However, if they are low, they may grossly understate how cold the victim really is, and should be followed with a rectal measurement. Digital electronic eardrum scanners used to measure temperature may also yield a false (compared to the core) reading.

Unless the victim has suffered a full cardiopulmonary arrest, the hypothermia itself may not be harmful. Unless tissue is actually frozen, cold is in many ways

protective to the brain and heart. However, if a hypothermic victim is improperly transported or rewarmed, the process may precipitate ventricular fibrillation, in which the heart does not contract, but quivers in such a fashion as to be unable to pump blood. *The burden of rescue is to transport and rewarm the victim in a way that does not precipitate ventricular fibrillation.*

The following general rules of therapy apply to all cases:

1. Handle all victims gently. Rough handling can cause the heart to fibrillate (cause a cardiac arrest). Secure the scene and avoid creating additional victims via unstable snow, ice, or rock fall.
2. If necessary, protect the airway (see page 22) and cervical spine (see page 37). Stabilize all other major injuries, such as broken bones.
3. Prevent the victim from becoming any colder. Provide a shelter. Remove all his wet clothing and replace it with dry clothing. Don't give away all of your clothing, however, or *you* may become hypothermic. Replace wet clothing with sleeping bags, insulated pads, bubble wrap, blankets, or even newspaper. The "blizzard pack" from Blizzard Protection Systems, Ltd. (www.blizzardpack.com) can be used to provide protection from the elements. The Pro-Tech Extreme bag or vest, SPACE brand emergency bag, SPACE brand all-weather blanket, and SPACE brand emergency blanket, all from MPI Outdoors (www.mpioutdoors.com), are other options for this purpose.

Cover the victim's head and neck. Insulate the victim from above *and below* with blankets. Do not change blankets unless necessary to keep the victim dry. If possible, put him in a sleeping bag sandwiched between two warm rescuers. But remember that in this situation, no heat is really contributed by the bag itself. Do not count on a sleeping bag to be adequately prewarmed by a normothermic rescuer's body heat. Another technique is to blow warm air from an electric hair dryer into the bag with the victim. Hot water in bottles, *well insulated with clothing to prevent skin burns*, may be placed next to the victim in areas of high heat transfer, such as the neck, chest wall, and groin. A great deal of warmth may be conserved by using a thin liner bag inside a normal sleeping bag.

4. Do not attempt to warm the victim by vigorous exercise, rubbing the arms and legs, or immersing in warm water. This is "rough handling" and can cause the heart to fibrillate if the victim is severely hypothermic.
5. Seek assistance as soon as possible.

Mild Hypothermia

The victim of mild hypothermia is awake, can answer questions intelligently, and complains of feeling cold. He may or may not be shivering.

Prevent the victim from becoming any colder. Get him out of the wind and into a shelter. If necessary, build a fire or ignite a stove for added warmth. Gently remove wet items of clothing and replace them with dry garments. This is very important, even if the victim will be very briefly exposed out in the open. If no dry replacements are available, the clothed victim should be covered with a waterproof tarp or poncho to prevent evaporative heat loss. Cover the head, neck, hands, and feet. Insulate the victim above and below with blankets. If the victim is coherent and can swallow without difficulty, encourage the ingestion of warm sweetened fluids. Good choices include warm gelatin (Jell-O), juice, or cocoa, because carbohydrates fuel shivering. If only cool or cold liquids are available for drinking, this is fine. Avoid heavily caffeinated beverages. If a dry sleeping bag is available, one or more rescuers should climb in with the victim and share body heat. However, this technique may not be very effective, and great care must be taken not to cause the victim to become wet (e.g., from the rescuer's sweat). Do not apply commercial heat packs, hot-water-filled canteens, or hot rocks directly to the skin; they must be wrapped in blankets or towels to avoid serious burns. Try to keep the victim in a horizontal position until he is well hydrated. Do not vigorously massage the arms and legs, because skin rubbing suppresses shivering, dilates the skin, and does not contribute to rewarming.

Moderate Hypothermia

The victim of moderate hypothermia has become apathetic and mildly confused, wishes to be left behind, and is uncooperative. Speech is often slurred, and logic is on the wane. The victim rapidly becomes uncoordinated and clumsy, often stumbling. He has ceased to shiver, and shows signs of muscle stiffness. Unless you have a thermometer to measure this victim's temperature, you must assume that he is severely hypothermic or will soon become so. Follow the directions for mild hypothermia, with the added caution that it is best not to allow this victim to walk about until he is fully alert; in addition, do not give him fluids to drink until he becomes wide awake and understands what is going on.

Severe Hypothermia

Depending on the body temperature, a victim who appears to be asleep may be in a complete coma. Below 86°F (30°C), humans become poikilothermic, like a snake, and take on the temperature of the environment.

Examine the victim carefully and gently for signs of life. Listen closely near the nose and mouth and examine chest movement for spontaneous breathing. Feel at the groin (femoral artery) and neck (carotid artery) for a weak and/or slow pulse (see page 33).

If the victim shows any signs of life (movement, pulse, respirations), do not initiate the chest compressions of cardiopulmonary resuscitation (CPR). If the victim is

breathing regularly, even at a subnormal rate, his heart is beating. Because hypothermia is protective, the victim does not require a “normal” heart rate, respiratory rate, and blood pressure. Pumping on the chest unnecessarily is “rough handling,” and may induce ventricular fibrillation. Administer supplemental oxygen (see page 431) by facemask if it is available.

If the victim is breathing at a rate of less than 6 to 7 breaths per minute, you should begin mouth-to-mouth breathing (see page 29) to achieve an overall rate of 12 to 13 breaths per minute.

If help is on the way (within 2 hours) and there are no signs of life whatsoever, or if you are in doubt (about whether the victim is hypothermic, for instance), you should begin standard CPR (see page 32). If possible, continue CPR until the victim reaches the hospital. Rescue breathing should take priority over chest compressions, particularly in the victim of cold-water immersion. There have been documented cases of “miraculous” recoveries from complete cardiopulmonary arrest associated with environmental hypothermia after prolonged resuscitation, presumably because of the protective effect of the cold. Remember, “no one is dead until he is warm and dead.” However, all of these victims were ultimately resurrected in the hospital, after they had been fully rewarmed.

A victim of severe hypothermia cannot be rewarmed in the field. If a hypothermic victim suffers what you determine to be a cardiac arrest in the wilderness, transport should be the first priority. If enough rescuers are present to allow CPR and simultaneous transport, do both. If you are the only person present, do not bother with CPR, because you will not be able to resuscitate the victim until he is rewarmed. Your only hope is that the victim is in a cold-protected state (“metabolic icebox”) and that you can extricate him (as gently as possible!) to sophisticated medical attention.

In any case of severe hypothermia, transport should be undertaken as soon as possible. Take care to cover the victim with dry blankets and to handle him as gently as possible. Rapid rewarming or restoration of circulation will release cold, acid-laden blood from the limbs back to the core organs, which may cause a profound deterioration of the victim.

Preparing a Hypothermic Victim for Transport

1. Keep the victim dry. Replace all wet clothing. If there is no replacement clothing available, wring out the wet clothing, including gloves and mittens, and then put it back on the victim. Lay the victim on a sleeping bag and then cover him with a layer of blankets. If necessary, use bubble wrap or some other insulating material. If the hands are extremely cold, pull them out of the sleeves of clothing in order to put the hands in the victim’s armpits for warming. See above for emergency waterproof blankets and bags. Cover everything with a plastic sheet.
2. Keep the victim horizontal. Do not allow massage of the extremities. Do not allow the victim to exert himself.

3. Splint and bandage all injuries as appropriate. Cover all open wounds.
4. Limit rewarming to methods that prevent further heat loss. Place insulated (e.g., with clothing) hot-water bottles in the victim's armpits and groin. Keep his head and neck covered.

A Special Note about the Victim of Cold-Water Drowning

If a victim is pulled from icy waters and appears to be clinically dead (fixed dilated pupils, no respirations, no detectable pulse), perform CPR until a qualified medical person is available to intervene or you become exhausted. Because of the physiology of cold-water immersion, the victim may be sufficiently protected to survive the event.

Prevention of Hypothermia

1. Carry adequate food and thermal wear, such as Thermax, Capilene, and/or polypropylene ("polypro") or wool undergarments. Anticipate the worst possible weather conditions. Dress in layers so that you can adjust clothing for overcooling, overheating, perspiration, and external moisture. Use a foundation layer to wick moisture from the body to outer layers. The first layer (such as CoolMax) should keep the skin cool and dry (to avoid perspiration). Add an insulation layer to provide incremental warmth. For shirts, use wool, fleece, Capilene, or polypropylene. Consider a turtleneck or neck gaiter. For pants, wear wool or pile, with a fly. Carry windproof and waterproof outer garments, mittens or gloves (with glove liners), socks, and a hat. In very cold weather, up to 70% of generated heat may be lost by radiation from the uncovered head. Boots should be large enough to accommodate a pair of polypropylene socks ("liner socks") plus at least one pair of heavy wool socks without cramping the toes.
2. Stay dry. Avoid sweating.
3. Keep hands and feet dry. This is important to avoid frostbite as well. Hand Sense is a cream that can be applied to the hands to keep them dry by reducing perspiration. It was designed as a topical protectant, and is not a moisturizer. For the feet, aluminum chlorohydrate-containing antiperspirant sprayed onto the skin can help control sweating. Do this three times a week for the first week of winter, then once a week after that. Avoid leather boots that become soaked with moisture and do not dry out easily.
4. Do not exhaust yourself in cold weather. Do not sit down in the snow or on the ice without insulation beneath you.
5. Seek shelter in times of extreme cold and high winds. Don't sit on cold rocks or metal. Insulate yourself from the ground with a pad, backpack, log, or tree limb. Carry a properly rated (for the cold) sleeping bag stuffed with Hollofil II, Quallofil, or down. Insulate hands and feet well, even when you

are in your sleeping bag, which should be fluffed up before entry. Do not enter a sleeping bag if you are wet without drying off first if possible.

6. Do not become dehydrated. In the cold, dehydration is caused by evaporation from the respiratory tree, increased urination, and inadequate fluid intake. Drink at least 3 to 4 quarts (liters) of fluid daily. During extreme exercise, drink at least 5 to 6 quarts per day. Ingesting snow is an inefficient way to replace water, because it worsens hypothermia. Drink cold water from a stream in preference to eating snow. Do not skip meals. Do not consume alcoholic beverages in cold weather. They cause an initial sensation of warmth because of dilation of superficial skin blood vessels, but this same effect contributes markedly to heat loss. At night, fill a canteen or Nalgene water container with at least 1 quart (liter) of water, and sleep with it to keep it from freezing.
7. Consume adequate calories.

WHAT TO DO IF YOU FALL THROUGH THE ICE

If you fall through the ice into very cold water, the “1-10-1 Principle” states that a person has 1 minute to get breathing under control, 10 minutes of meaningful movement, and 1 hour before one goes unconscious due to hypothermia:

1. When a person falls into extremely cold water, he begins to gasp and hyperventilate. Control your breathing. Calm down and slow your breathing rate, so that you are not hyperventilating. This generally takes 30 seconds to 2 minutes.
2. Keep your hands and arms on top of the ice and kick your feet vigorously, to bring your body to a horizontal position and propel you up onto the ice. Otherwise, keep swimming at a minimum. Keep clothing on in the water—it contributes to insulation and helps with flotation. If you are able to slide your body out of the water onto the ice, do not stand up. Roll or slide your body away from the opening onto thicker ice, where you may now stand. Try to leave in the direction from which you first approached, as this ice has already proven that it can withstand your weight. If you cannot exit the water, try to hold your arms on top of the ice, so that they freeze to the ice, which will prevent you from submerging under the surface of the water. This may give you an extra hour of survival time.

HOW TO ASSIST SOMEONE WHO HAS FALLEN THROUGH THE ICE

If someone has fallen through the ice, it is an urgent and dangerous situation. Although it is important to rescue the victim, it is equally important to not create additional victims.

1. Recognize that ice conditions are unsafe. No one else should approach the area.
2. Resist the urge to rush up to help the victim, so that you don't also fall through the ice. Encourage the victim to remain calm and not panic. Direct the victim to an area of strong ice and to attempt a self rescue, as described above.
3. If self rescue is not accomplished, you can throw a buoyant object to the victim to help him remain floating. Before it is thrown, tie a rope or cord to the object, so that if the victim can hold onto it, you might be able to pull the victim. If only a rope is available, tie a large loop at the end, which the victim can grab. Instruct the victim to put the loop over the body and under the arms, put one arm through the loop and bend his elbow around the rope, or just hold on.
4. The victim might be reached with a long tree branch, ladder, or other object that can be pushed along the surface of the ice. It is important for the rescuer to not get too close to the hole in the ice.
5. If the victim cannot be removed from the water using the techniques above, he should be instructed to hold the arms up on the ice for the purpose of letting them freeze to the ice while help is summoned.
6. To avoid falling through ice in the first place, you should look for signage that might indicate its safety or unsafety; check with local authorities if they have any information; travel across ice under observation of someone else; bring safety equipment; wear a lifejacket or other flotation device; avoid traveling on ice at night; select "blue ice" over white ice or gray ice; and avoid ice with cracks or slushy areas.

WINTER STORM PREPAREDNESS

Outdoor, and indeed urban, travelers should always plan for the unusual and unexpected. Tools include familiarity with weather forecasts, strategizing worst-case scenarios, carrying emergency items, avoiding solo travel, and leaving notice of the projected route and expected time of return. With good planning, deteriorating weather or a forced unexpected night outdoors might then become more of an inconvenience than a life-threatening ordeal. While we usually consider a life-or-death situation due to the elements to be associated with a remote expedition or natural disaster, it can happen during a routine drive along the highway on the way to a ski destination.

Winter storm preparedness is essential for anyone who drives a motor vehicle in snow country. One must always be aware of the possibility of spending an unplanned night out in a vehicle. Causes include bad weather, breakdown, having an accident, running out of fuel, becoming lost, and getting stuck. Winter driving is especially hazardous because of the dangers of driving on snow or ice, losing visibility and orientation, fewer people on the road from whom to receive assistance, and the threats of frostbite and hypothermia. Accepting the possibility

of trouble, carrying a vehicle survival kit (see below), and giving some thought to survival strategies will help prevent a night out in your car from deteriorating into a life-threatening experience.

Most travelers dress to arrive at a destination and not to survive a night out; in other words, they dress “to arrive, not to survive.” A vehicle survival kit (listed below) should include extra clothing, blankets or sleeping bags, food, water, signaling equipment, and communications equipment (cell phone, citizen’s band radio, etc.). It is also always better to stay with the vehicle, which provides significant protection and which is more visible to rescuers than a person on foot. Most laypersons are not experienced trail-blazing in wilderness environments, and particularly when landmarks are obscured by rain or snow, and darkness and cold weather conspire to alter orientation and judgment.

In cold weather, and especially for long-distance travel, drivers should keep their vehicles in the best possible mechanical condition. Drivers should use winter-grade oil, the proper amount of radiator antifreeze, deicer fluid for the fuel tank, and antifreezing solution in the windshield-cleaning fluid. Windshield wiper blades that are becoming worn should be replaced and special snow-and-ice-resistant blades used when available. A combination snow brush and ice scraper should be carried. A can of deicer is useful for frozen door locks and wiper blades. Snow tires, preferably studded (illegal in some states), are desirable, but even with special tires and/or four-wheel drive, chains should be carried. All-wheel drive or four-wheel drive is optimal, and front-wheel drive is superior to rear-wheel drive. The battery should be kept charged, the exhaust system free of leaks, and the gas tank full (“drive on the upper half of your tank”).

Despite best efforts, you may become stranded or lost. If that happens, tie a brightly colored piece of cloth (such as a length of surveyor’s tape) to the antenna. At night, leave the inside dome light illuminated so that it may be seen by snowplow drivers and rescuers. Headlights use too much current, so use the dome light. If necessary for heat, the standard recommendation has been that the motor and heater can be run for 2 minutes each hour (after checking to see if that exhaust pipe is free of snow). However, a more recent recommendation is that since it takes more gasoline to start a cold engine than a warm one, one should initially turn the heat up all the way and run the car engine until the inside is comfortable. Then, shut off the engine and wait until it becomes uncomfortably cold inside the car (which could be 10 to 30 minutes depending on outside temperature). The engine, however, will still be “warm.” Start the engine again and run the heater until the occupants feel warm. Keep repeating this process.

Keep the tailpipe free from snow pack. Carbon monoxide (CO) poisoning can be a threat, so do not go to sleep inside the car with the engine running; if the engine is running, keep a downwind window cracked 1 to 2 inches in case there is a CO leak into the interior of the vehicle. A reusable CO detector is a wise addition to the survival kit. One or two large candles (“fat Christmas candle” size) should be carried to provide heat and light if the gasoline supply runs out, since two lit candles can raise the interior temperature well above freezing. However, resources should be used sparingly because you are never sure how long you will be stranded.

Foresight enough to include heavy clothing and blankets or sleeping bags in the cold-weather vehicle survival kit is better than relying excessively on external heat generation. Do not smoke tobacco products or drink alcohol. If you have to exit the vehicle in a snowstorm, put on additional windproof clothing and snow goggles, and tie a lifeline to yourself and the door handle before moving away from the vehicle.

You must decide whether to wait for rescue or attempt to walk out under your own power. If rescue is possible, it is almost always better to remain in a snug shelter and conserve your strength. If you decide to leave, you must effectively mark your trail, to aid rescuers and enable you to return to the site if necessary. Travel should never be attempted in severe or extremely cold weather, or in deep snow without snowshoes or skis. If no chance of rescue exists, prepare as best as possible, wait for good weather, and then travel in the most logical direction.

The best way for a lost or stranded person to aid potential rescuers is to do everything possible to draw attention to his or her location. Most modern rescues utilize ground parties, helicopters, and fixed-wing aircraft. Besides radios, cell phones, and other electronic equipment, signaling devices are either auditory or visual. Three of anything is a universal distress signal: three whistle blasts, three horn blasts, three fires. The most effective auditory device is a whistle. Blowing a whistle is less tiring than shouting, and the distinctive sound can be heard farther than a human voice. An effective visual ground-to-air signal device is a glass signal mirror with a sighting device, which can be seen up to 10 miles away but requires sunlight. Special rescue beacons are available and can be carried as emergency equipment. These include strobe lights, laser signal lights, special beacons with both signaling and GPS capability, and personal locator beacons (PLBs).

Smoke is easily seen by day and a fire or flashlight by night. On a cloudy day, black smoke is more visible than white; the reverse is true on a sunny day. White smoke stands out well against a green forest background but not against snow. Black smoke can be produced by burning parts of a vehicle, such as rubber or oil, and white smoke by adding green vegetation to a fire. The lost person who anticipates an air search should keep a fire going with large supplies of dry, burnable material (wood and brush) and have a large pile of cut green vegetation close by. When an aircraft is heard, the dry materials are placed on the fire, allowed to flare, and then armloads of the green vegetation are piled on top. This produces lots of smoke and a hot thermal updraft to carry it aloft.

A vehicle cold weather survival kit should include the following items:

1. Sleeping bag or two blankets for each occupant
2. Extra winter clothing, including gloves, boots, and snow goggles, for each occupant
3. Emergency food
4. Metal cup
5. Waterproof matches
6. Long-burning candles, at least two

7. First-aid kit
8. Spare doses of personal medications
9. Swiss army knife or Leatherman-type multitool
10. Three 3 lb empty coffee cans with lids, for melting snow or sanitary purposes
11. Toilet paper
12. Cell phone and/or citizen's band radio, with chargers
13. Portable radio receiver, with spare batteries
14. Flashlight with extra batteries and bulb
15. Battery booster cables and/or car battery recharging unit (plugs into cigarette lighter)
16. Extra quart of automobile oil (place some in hubcap and burn for emergency smoke signal)
17. Tire chains
18. Jack and spare tire
19. Road flares
20. Snow shovel
21. Windshield scraper and brush
22. Tow strap or chain
23. Small sack of sand or cat litter
24. Two plastic gallon drinking water jugs, full
25. Tool kit
26. Gas line deicer
27. Flagging, such as surveyor's tape (tie to top of radio antenna for signal)
28. Duct tape
29. Notebook and pencil/marker
30. Long rope (e.g., clothesline) to act as safety rope if you leave car in blizzard
31. Carbon monoxide detector
32. Ax
33. Saw
34. Full tank of gas

FROSTBITE

Frostbite is an injury caused by the actual freezing of tissues. Factors that predispose a person to frostbite include poor circulation (caused by previous cold injuries, tobacco use, alcohol ingestion, diseases of the blood vessels, constricting garments, poorly fitting boots, old age), fatigue, and extremes of cold exposure. Windchill contributes markedly to frostbite risk. For instance, at an air temperature of 15°F (−9.4°C), a 55 mph (88 km per hour) wind causes the same rate of heat loss as a 5 mph (8 km per hour) breeze at an air temperature of 0°F (−17.8°C). Furthermore, since a human in motion creates his own wind (while riding a snowmobile, for example), the risk for frostbite for such a person increases. Humidity and wetness also increase the propensity for frostbite.

During exposure, once the temperature of a hand or foot drops to 59°F (15°C), the blood vessels maximally constrict and minimal blood flow occurs. As the limb temperature declines to 50°F (10°C), there may be brief periods of blood vessel dilation, alternated with constriction, as the body attempts to provide some protection from the cold. This is known as the “hunting response” and is seen more commonly in the Inuit (Eskimos) and those of Nordic descent. Below 50°F (10°C), the skin becomes numb and injury may go unnoticed until it is too late. Tissue at the body surface freezes at or below a temperature of 24.8°F (−4°C) because of the effect of underlying warm tissue. Once circulation is abolished, the skin temperature may drop at a rate in excess of 1°F (0.56°C) per minute. Once tissue freezes, it cools rapidly to attain the temperature of the environment.

The major immediate symptom of a frostbite injury is numbness, occasionally preceded by itching and prickly pain. The frostbitten area will appear to be white, with a yellow or bluish (grayish) waxy (sometimes mottled) tint. If the injury is superficial, as commonly occurs on the face, the skin is firm and may indent with a touch, because the underlying tissue is still soft and pliable. If the injury is deep, the skin may feel hard and actually be frozen solid. A hand or foot may feel clumsy or absent. The areas most commonly affected are the fingertips and toes (particularly in cramped footwear), followed by the earlobes, nose tip, cheeks, and other exposed skin. These parts have little heat-generating capability and no significant insulation. Male joggers have had their genitals frostbitten.

Rapid rewarming is the standard therapy. However, *do not thaw out a frostbitten body part if it cannot be kept thawed*. In other words, if you come on a lost hiker 10 miles (16 km) back in the woods who has frostbitten toes, do not use your stove to heat water to thaw out his feet if he will then have to put his wet boots back on and hike out—refreezing his toes in the process. Frostbitten tissue is severely damaged and is prone to reinjury; refreezing causes an injury that will far exceed the initial frostbite wound. It is much better to walk out on frostbitten toes until safety is reached than to thaw and allow refreezing. Thus, if a victim needs to be transported to another site for rewarming, do not allow “slow” or partial rewarming, particularly if there is a chance that the tissue will be allowed to refreeze. Pad the affected body part, apply a protective splint, and hustle the victim to the site where the definitive thaw will take place. Do not allow tobacco or alcohol use.

Once the victim has reached a location (shelter) where refreezing will not occur, remove all constrictive jewelry and wet clothing. Replace wet clothes with dry garments. Immerse the frostbitten part in water heated to 104°F to 108°F (40°C to 42.2°C). Do not induce a burn injury by using hotter water. You can estimate 108°F (42.2°C) water by considering it to be water in which normal skin can be submerged for a prolonged period with minimal discomfort. Heated tap water may be too hot. Never use a numb frostbitten finger or toe to test water temperature. It is best to use your own hand or the victim’s uninjured hand to test the temperature. Circulate the water to allow thawing to proceed as rapidly

as possible. When adding more hot water, take the body part out, add the water, test the temperature, and then reimmerge the part. It is best to use a container in which the body part can be immersed without touching the sides; for instance, a 20-quart (20-liter) pot will accommodate a foot. If the skin is frozen to mittens or metal, use heated water to remove them. *Never rewarm the tissues by vigorous rubbing or by using the heat of a campfire, camp stove, or car exhaust*, because you most certainly will damage the tissues.

If the victim is hypothermic, attend first to the hypothermia. Thawing should not be undertaken until the core body temperature has reached 95°F (35°C) (see page 305).

Thawing of the tissues usually requires 30 to 45 minutes. It is complete when the skin is soft and pliable, and color (usually quite red; rarely, bluish) and sensation have returned. Allowing the limb to move in the circulating water is fine, but massage may be harmful. Moderate to extreme burning pain may occur during the last 5 to 10 minutes of rewarming, particularly if the frostbitten tissue was numb before rewarming.

Thawed frostbite may be present in a number of stages, much like a burn injury. These are recognized as follows:

First degree. Numbness, redness, and swelling; no tissue loss.

Second degree. Superficial blistering, with clear (yellowish) or milky fluid in the blisters, surrounded by redness and swelling. There is little, if any, tissue loss.

Third degree. Deep blistering, with purple blood-containing fluid in the blisters. There is usually tissue loss.

Fourth degree. Extremely deep involvement (including bone); induces mummification. There is always tissue loss.

Sensation may remain until blisters appear at 6 to 24 hours after rapid rewarming. These often do not extend to the ends of fingers and toes (Figure 177). Leave these blisters intact. After thawing the skin, protect it with fluffy, sterile bandages (aloe vera lotion, gel, or cream should be applied, if available). Pad gently between the digits with sterile cotton or wool pads, held in place by a loose, rolled bandage. Transport the victim to a medical facility. Administer ibuprofen 400 mg or aspirin 325 mg twice a day. If frostbite involves the feet, try to minimize walking. Do not allow tobacco use or the drinking of alcohol. Keep the victim well hydrated with warm beverages. Administer pain medications as needed.

After the thaw, if the victim is days away from hospital care, manage the wound as follows:

1. If you don't have sufficient sterile bandages to redress the wounds at least once a day until you reach a hospital, allow blisters to remain intact. Apply topical aloe vera gel or lotion twice a day. Cover with sterile gauze.
2. If white or clear blisters begin to leak, trim them away and apply antiseptic ointment (mupirocin or bacitracin) or cream (mupirocin). If antiseptic ointment is not available, continue with aloe vera gel or lotion. Cover with a sterile dressing (see page 276), taking particular care to pad with cotton or gauze between fingers and toes.



Figure 177. Blisters of frostbite may not extend to the ends of fingers and toes.

3. If at all possible, keep purple or bloody blisters intact, because they provide a covering that keeps the underlying damaged tissue from drying out. Apply topical aloe vera gel or lotion twice a day. Cover with sterile gauze.
4. Elevate the affected part.
5. Apply a protective splint (see page 74) if necessary to surround the bulky cushion dressing.
6. For the first 72 hours after the injury, administer dicloxacillin, cephalexin, or erythromycin.
7. If the skin blackens and begins to harden, apply topical mupirocin or bacitracin ointment, or mupirocin cream, daily to the margin where the dying skin meets the normal skin.

Throbbing pain may begin a few days after rewarming and continue for up to a few weeks. After the pain subsides, it is not unusual for the victim to notice a residual tingling sensation. If there is no tissue loss, the duration of abnormal sensation may be only a month; with extensive tissue loss, it can exceed 6 months. Intermittent burning pain or electric-current–like sensations may be present.

Tissue that has been destroyed by frostbite will usually harden and turn black in the second week after rewarming, forming a “shell” over the viable tissue underneath. If the destruction is extensive, the affected area will wither and shrivel beneath the blackness, and self-amputate over 3 to 6 months. If the victim cannot seek medical care in that interval, the wound should be kept clean and dry, and signs of infection (see page 240) treated appropriately with antibiotics.

The corneas can be frostbitten if people (such as snowmobilers) force their eyes open in situations of high windchill. Symptoms include blurred vision, aversion to light, swollen eyelids, and excessive tearing. The treatment is the same as for a corneal abrasion (see page 180).

Prevention of Frostbite

1. Dress to maintain body warmth. Wear adequate, properly fitting (not tight) clothing, particularly boots that can accommodate a pair of polypropylene socks and at least one pair of wool socks without cramping the toes or wrinkling the socks. Dress your feet for the temperature of subsurface colder snow, not the “warm” snow at the surface. Take care to cover the head, neck, hands, feet, and face (particularly the nose and ears). Wear mittens in preference to gloves, to decrease the surface area available for heat loss from the fingers.

Mitten shells and gloves should be made of synthetics or soft, flexible, dry-tanned leather (e.g., moose, deer, elk, caribou) that won't dry stiffly after it becomes wet. Do not grease the leather. Mitten inserts and glove linings should be made of soft wool. Tie mittens and gloves to sleeves or string them around the neck, so they are not dropped or lost. Carry pocket, hand, and/or foot warmers and use them properly. Choices include fuel-burning warmers or chemical (such as Grabber hand warmer) packs, reusable sodium acetate thermal packs, or air-activated, single-use hand and pocket warmers.

2. Keep clothing dry. Avoid perspiring during extremely cold weather. Keep skin dry and avoid moisturization.
3. Do not touch bare metal with bare skin. Certain liquids (such as gasoline) become colder than frozen water before they freeze, and can cause frostbite. Cover all metal handles with cloth, tape, or leather. Take care when handling cameras. For brief periods of exposure when dexterity is required, wear silk or rayon gloves.
4. Do not maintain one position in the cold for a prolonged period of time. Avoid cramped quarters.
5. Wear a sunscreen with a cream or grease base to prevent windburn.
6. Stay well hydrated. Eat enough food to maximize body-heat production. Avoid becoming fatigued.
7. Do not overwash exposed skin in freezing weather. The natural oils are a barrier to cold injury. Shave sparingly or not at all for cosmetic reasons. If skin becomes exceedingly dry, apply a thin layer of petrolatum-based ointment.
8. Do not drink alcohol or use tobacco products.
9. Keep fingernails and toenails properly trimmed.
10. Do not climb during extreme weather conditions.

FROSTNIP

Frostnip is reversible ice-crystal formation that occurs on the surface of the skin. It is distinct from frostbite in that actual freezing of the tissues does not occur. However, because the symptoms (numbness, frosted appearance) may resemble those of frostbite, it should be taken as a serious warning that the skin is not adequately protected.

IMMERSION FOOT (TRENCH FOOT)

Immersion, or "trench," foot (affecting lower limbs) is caused by prolonged (hours to days) exposure to cold water or to conditions of persistent cold (32°F to 59°F, or 0°C to 15°C) and high humidity, without actual freezing of tissues. Symptoms include itching, tingling, and eventually numbness. At first, the skin appears blanched, yellowish-white or mottled, but rarely blistered. It is not painful, but muscle cramps may be present.

If you suspect immersion foot, carefully cleanse and dry the limb, and rewarm it. After the limb has initially been fully rewarmed, it may become very reddened, warm to the touch, swollen, and painful. Then, maintain it in an environment where the victim can be kept warm while the injured limb(s) can be kept cool (not cold). Do not rub the limb. Pain reaches its maximum intensity in 24 to 36 hours, and may be worsened at night. If the limbs are held in a dependent position, they may turn purplish in color; when raised, they may blanch. Treat the injury as a combination of frostbite and a burn wound, using daily dressing changes, topical antiseptic ointments, and antibiotics if necessary to treat any infection. If left unattended, immersion foot can lead to prolonged disability. In a severe case, the skin may become gangrenous.

Prevention of immersion foot involves keeping the feet dry and warm. Change socks as often as necessary to accomplish this, and attempt to promote circulation to the feet. Avoid constrictive or nonventilated (rubber) footwear. Wear properly fitted boots. Silicone ointment applied to the soles may be preventive. There are special boots (OTB Footwear) designed with perforations through the sole to drain water. These should be considered in special circumstances.

CHILBLAIN (PERNIO)

Chilblain is less severe than immersion foot. It mostly afflicts women, who develop patches of redness or blue discoloration, nodules, and, rarely, blisters or ulcerations on the lower legs, feet, thighs, toes, hands, and ears. The skin changes appear approximately 12 hours after cold exposure, and are accompanied by intense itching and burning or tingling sensations.

Treatment involves rewarming the affected skin, keeping it washed and dried, gentle massage of the tissues, and covering the nodules with dry, soft, and sterile bandages. Affected limbs should be elevated to minimize swelling. Rewarming should not exceed 86°F (30°C), to minimize pain. In a severe case, nifedipine 20 mg by mouth three times a day for a few days has been shown to be effective. After rewarming, the tender blue skin nodules may persist for up to 3 weeks. Once healing has occurred, the skin may remain darkened.

Women with a past history of pernio or history of Raynaud's phenomenon (constriction of small blood vessels, leading to painful hands and feet that become pale or blue on exposure to cold—see below) seem to be more prone to an episode. A topical lanolin-based lotion or emollient (hydrating) cream may be helpful in prevention.

RAYNAUD'S PHENOMENON

Raynaud's phenomenon is constriction of tiny blood vessels in the fingers and/or toes after exposure to cold or an emotionally stressful situation. The initial appearance is one of severely blanched (whitened) or bluish skin, often with

a sharp “cut-off” margin in the midportion of the digit(s). This is caused by decreased circulation. The episode ends with vigorous reflow of blood into the digit, which causes it to become warm and reddened. This phenomenon is different and much more pronounced than the normal mottling or diffuse and persistent discoloration sometimes seen in hands and feet exposed to cold. Raynaud’s phenomenon is usually symmetrical, involving both hands or both feet, and is usually apparent in sufferers by age 40 years. Because Raynaud’s phenomenon can be associated with a number of underlying diseases or anatomic abnormalities, a first-time sufferer should seek medical evaluation. Prevention in the outdoors involves primarily protecting the hands and feet and keeping them warm, avoiding drugs that cause blood vessel constriction, and prohibiting tobacco use. Many drugs have been recommended at one time or another to treat Raynaud’s phenomenon, but at the current time the calcium-channel blockers (such as nifedipine) and drugs that block the sympathetic nervous system (which causes blood vessels to constrict) are most in favor as therapies for use outside of the hospital. Blood vessel dilators, such as nitroglycerin or niacin, have not been proven effective.

HIVES INDUCED BY EXPOSURE TO COLD

See page 238. Treatment is not as satisfactory as for hives due to an allergic reaction, in that antihistamines do not seem to be of great benefit.

SNOWBLINDNESS

See page 187.



INJURIES AND ILLNESSES DUE TO HEAT

BURN INJURIES

See page 108.

HEAT ILLNESS (HYPERTHERMIA)

The human core temperature is maintained at 98.6°F (37°C), with little variation from individual to individual. Heat is generated by all of the metabolic processes that contribute to life, from the blink of an eyelid to the completion of a marathon, and must be shed constantly to avoid a condition of overheating. The resting person generates enough heat (60 to 80 kilocalories per hour) to raise body temperature by 1.8°F (1°C) per hour. A person exposed to the sun can absorb 150 kilocalories of energy an hour. Vigorous exercise can increase endogenous heat production 10-fold. As outlined in the section on hypothermia (see page), heat is lost to the environment through conduction, convection, radiation, and evaporation:

Conduction—heat exchange between two surfaces in direct contact. Lying uninsulated on hot (or cold) ground can result in significant heat exchange. The same is true for immersion into hot or cold water.

Convection—heat transferred from a surface to a gas or liquid, commonly air or water. When air temperature exceeds skin temperature, heat is gained by the body. Loose-fitting clothing allows air movement and assists conductive heat loss.

Radiation—heat transfer between the body and the environment by electromagnetic waves. Clothing protects the body from radiant heat, and the skin radiates heat away from the body. Highly pigmented skin absorbs more heat than nonpigmented skin.

Evaporation—consumption of heat energy as liquid is converted to a gas. Evaporation of sweat is an effective cooling mechanism.

In the normal situation, the skin is the largest heat-wasting organ, and radiates approximately 65% of the daily heat loss. The skin is also largely responsible for evaporation (of sweat). Extreme humidity impedes evaporation and greatly diminishes human temperature control. The National Weather Service heat index (Figure 178) roughly correlates air temperature and relative humidity to derive an “apparent temperature.” At all temperatures, humidity makes the situation worse. For instance, at an air temperature of 85°F, if the relative humidity is 80%, the apparent temperature is 97°F.

To summarize these recommendations:

Apparent Temperature Range	Dangers/Precautions at This Range
80°F–90°F (27°C–32°C)	Exercise can be difficult; enforce rest and hydration
90°F–105°F (32°C–41°C)	Heat cramps and exhaustion; be extremely cautious
105°F–130°F (41°C–54°C)	Anticipate heat exhaustion; strictly limit activities
130°F and above (54°C and above)	Setting for heatstroke; seek cool shelter

RELATIVE HUMIDITY (%)	AIR TEMPERATURE (°F)										
	70	75	80	85	90	95	100	105	110	115	120
APPARENT TEMPERATURE (°F)											
0	64	69	73	78	83	87	91	95	99	103	107
10	65	70	75	80	85	90	95	100	105	111	116
20	66	72	77	82	87	93	99	105	112	120	130
30	67	73	78	84	90	96	104	113	123	135	148
40	68	74	79	86	93	101	110	122	137	151	
50	69	75	81	88	96	107	120	135	150		
60	70	76	82	90	100	114	132	149			
70	70	77	85	93	106	124	144				
80	71	78	86	97	113	136	157				
90	71	79	88	102	122	150	170				
100	72	80	91	108	133	166					

Figure 178. Heat index. Humidity contributes greatly to the accumulation of heat; when both are excessive, human temperature control is diminished.

When maximally effective, the complete evaporation of 1 quart (liter) of sweat from the skin removes 600 kilocalories of heat (equivalent to the total heat produced with strenuous exercise in 1 hour). Sweat that drips from the skin without evaporating does not contribute to the cooling process, but may contribute to dehydration. World-class distance runners who are acclimated to the heat can sweat in excess of $3\frac{1}{2}$ quarts per hour. Since the maximum rate of gastric emptying (a surrogate for fluid absorption) is only 1.2 quarts per hour, it is easy to see how a person can become dehydrated. Thus, a person should be able to tolerate a 1 quart per hour sweat rate and manage rehydration with oral fluids. The scalp, face, and torso are most important in terms of sweating.

When heat-control mechanisms are overloaded, the body responds unfavorably. As opposed to hypothermia, in which moderate cooling may offer a protective effect, the syndromes of true hyperthermia (in which core body temperature is measurably elevated) can rapidly become life threatening as the heat destroys the vital organs and dismembers chemical systems essential to life. Fever in and of itself can set off a vicious cycle, because raising the body temperature by 1.8°F (1°C) can increase metabolism by approximately 13%, which hastens the generation of more heat. Dehydration may by itself raise body temperature. For all of these reasons, it is crucial to be familiar with heat illness, and to be prepared to respond promptly and decisively.

HEAT EXHAUSTION AND HEATSTROKE

Heat exhaustion and heatstroke are part of the same continuum, but of differing severity. Heat exhaustion is illness caused by an elevation of body temperature that does not result in permanent damage. Heatstroke is life threatening and can permanently disable the victim.

The signs and symptoms of heat exhaustion are minor confusion, irrational behavior, a rapid weak pulse, dizziness, nausea, diarrhea, headache, and mild temperature elevation (up to 105°F, or 40.5°C). It is important to note that *sweating may be present or absent*, and that *the skin of the victim may feel cool to the touch*. It is the core temperature that is elevated and that must be measured (rectally).

The signs and symptoms of heatstroke are extreme confusion, weakness, dizziness, unconsciousness, low blood pressure or shock (see page 60), seizures, increased bleeding (bruising, vomiting blood, bloody urine), diarrhea, vomiting, shortness of breath, red skin rash (particularly over the chest, abdomen, and back), darkened (“machine oil”) urine, and major core body temperature elevation (up to 115.7°F, or 46.5°C, has been reported in a heatstroke survivor). Again, it is important to note that *sweating may be present or absent*. At the time of collapse, most victims of heatstroke are still sweating copiously. It is rare for someone to feel cool externally when his temperature exceeds 105°F (45°C), but it is not impossible.

The skin will usually be warm or hot to the touch when a victim suffers heat exhaustion or heatstroke, but, again, this is not absolutely constant. *Carry a rectal thermometer so you can take a temperature reading*. If no thermometer is available, and you are fairly certain that the victim is suffering from heat exhaustion or heatstroke, proceed with therapy.

The most important aspect of therapy is to *lower the temperature as quickly as possible*. The body may lose its ability to control its own temperature at 106°F (41.1°C), so from that point upward, temperature can skyrocket. Manage the airway (see page 22) and administer oxygen (see page 431) at a flow rate of 10 liters per minute by facemask. Do not give liquids by mouth unless the victim is awake and capable of purposeful swallowing. Cooled liquids do not assist the cooling process enough to risk choking the uncooperative or confused victim.

Cooling the Victim

1. Remove the victim from obvious sources of heat. Shield him from direct sunlight and remove his clothing. Stop him from exercising.
2. The most efficient method of cooling is to drench the victim with large quantities of crushed ice and water, accompanied by vigorous massage. If you have a limited amount of ice, place ice packs in the armpits, behind the neck, and in the groin. There are safety issues to consider with total body

immersion in cold water to treat hyperthermia, including access to the victim and even the risk for near-drowning. However, in a life-threatening field situation, if the only method available for cooling is immersion in a cold mountain stream, do it! Be alert for the need to remove the victim from the water to accomplish resuscitative measures (e.g., cardiopulmonary resuscitation [CPR]). Never leave the victim unattended.

3. If ice is not available, wet down the victim and begin to fan him vigorously. Evaporation is a very efficient method of heat removal. Use cool or tepid water; *do not sponge the victim with alcohol*. If electric fans are available, use them. Do not be concerned with shivering, so long as you continue to aggressively cool the victim.
4. There is a device on the market (CORECONTROL) for athletes that increases circulation through the hand to allow a cooling mechanism to have its effect on this area of brisk heat transfer.
5. Recheck the temperature every 5 to 10 minutes, to avoid cooling much below 98.6°F (37°C). When you have cooled the victim to 99.5°F to 100°F (37.5°C to 37.8°C), taper the cooling effort. After the victim is cooled, recheck his temperature every 30 minutes for 3 to 4 hours, because there will often be a rebound temperature rise.
6. *Do not use aspirin or acetaminophen unless the victim has an infection.* These specific drugs are used to combat fever that is caused by the release of chemical compounds from infectious agents into the bloodstream. Such compounds affect the portion of the brain (hypothalamus) that serves as the body's thermostat, causing body temperature to rise. Aspirin or acetaminophen acts to block this chemical interaction in the brain, and thus eliminates the fever. If elevated body temperature is not caused by an infection, aspirin or acetaminophen will not work—and may in fact be harmful, leading to bleeding disorders or liver inflammation, respectively.
7. If the victim is alert, begin to correct dehydration (see page 208) using oral rehydration. Be certain that the concentration of carbohydrates or sugar in the beverage does not exceed 6%, so as not to inhibit intestinal absorption. Try to get 1 to 2 quarts (liters) into the victim over the first few hours. For every pound (0.45 kg) of weight loss attributed to sweating, have the victim ingest a pint (473 mL or 2 cups) of fluid. This may take up to 36 hours.

MUSCLE CRAMPS

Muscle cramps in a warm environment accompany overuse (see page 284) or water and salt losses in the individual who exerts strenuously. A well-trained athlete can lose 2 to 3 quarts (liters) of sweat per hour (a potential 20 g sodium loss each day). In most cases, cramps are caused by replacement of water without adequate salt intake. Heat per se doesn't actually cause the cramps.

Treatment for cramps consists of gentle motion, massage, and stretching of the affected muscles, accompanied by fluid and salt replacement. This can be done by drinking water and balanced salt solutions or sports beverages before and during heavy exertion. One recommendation is to drink a solution that contains 3.5 g of sodium chloride and 1.5 g of potassium chloride in a quart (liter) of water. As a rough measure, $\frac{1}{4}$ to $\frac{1}{2}$ tsp (1.3 to 2.5 mL) of table salt in water will suffice. With proper fluid and electrolyte replacement, salt tablets (which irritate the lining of the stomach) are usually unnecessary.

HEAT SWELLING

In warmer climates, normal people, particularly elders, may suffer from swelling of the feet and ankles. This is noted after prolonged periods of walking or sitting and is not necessarily indicative of heart failure. Often, the swelling will disappear as a person becomes adjusted to the warm environment over several days. The swelling is painless and there is no sign of infection (redness). Body temperature is not elevated.

Treatment for heat swelling is to minimize periods of walking and to use support stockings that rise at least to midthigh. The legs should be elevated whenever possible. There is no reason to use fluid pills (diuretics). If the sufferer is short of breath or otherwise ill in association with leg swelling, he should seek the advice of a physician.

FAINTING

Fainting has many causes (see page 165). Fainting due to heat exposure occurs when a person (particularly an elder) adapts by dilating blood vessels in the skin and superficial muscles to deliver warm blood to the surface of the body, where the excess heat energy can be delivered back to the environment. The expansion of the superficial blood vessels allows a greater-than-normal proportion of the circulating blood volume to be away from the central circulation, which supplies, among other organs, the brain. This lack of sufficient central pressure is worsened when a person is on his feet for a prolonged period of time, because gravity allows a significant blood volume to pool in his lower limbs. Combined with fatigue and mild dehydration, the diversion of blood leads to a fainting episode, because not enough blood (with oxygen and glucose) is pumped to the brain. Dehydration can also stimulate the vagus nerve, which causes the heart rate to slow ("vasovagal" episode). A person with anemia, fever, low blood sugar, or acute injury may be particularly prone to fainting. Other risk factors for fainting due to vagal stimulation include prolonged standing, vigorous exercise in a warm environment, fear, emotional distress, and severe pain.

A victim who has suffered a fainting episode in the heat should be examined for any head or neck injuries, as well as other possible breaks or cuts.

Other causes of fainting (low blood sugar, abnormal heart rhythm, and so on) must be considered. If fainting is due to the heat, the victim will reawaken shortly, because assuming a horizontal position returns blood to the brain and solves the major problem. In general, body temperature is not elevated.

The victim of a fainting spell due to heat should be rested in a horizontal position for 15 to 30 minutes, and should not immediately assume a standing posture without first sitting for 5 minutes. Encourage him to consume a pint or two ($\frac{1}{2}$ to 1 liter) of cool sweetened liquid (such as Gatorade or Gatorade G2). To avoid further episodes, efforts should be made to avoid dehydration, missing meals, or standing in one position for a prolonged period. Support hose may help, as might regular leg muscle exercise. The victim should learn to recognize the warning signs of a fainting spell, which include dizziness, light-headedness, nausea, weakness, sweating, blurred vision, or seeing flashing lights. When a warning sign occurs, the victim should immediately assume a horizontal position or at least sit and lower his head to a position between his knees. If a person is wearing a tight collar and feels faint, loosen the collar. Any person over age 40 who suffers a fainting episode should eventually be examined by a doctor to be certain that the red blood count is normal and that there is no heart disease.

AVOIDING HEAT ILLNESS

1. Avoid dehydration. Drink 1 pint (473 mL) of liquid 10 to 15 minutes before beginning vigorous exercise. Drink at least 1 pint to 1 quart ($\frac{1}{2}$ to 1 liter) of liquid with adequate electrolyte supplementation (see below) each hour during heavy exercise with sweating in a hot climate. *Adequate water ingested during exercise is not harmful, does not cause cramps, and will prevent a large percentage of cases of heat illness.* Encourage rest and fluid breaks. The temperature of the fluid ingested should be cool, to encourage it to empty from the stomach. It is a myth that ingesting cold fluid causes abdominal cramps, so long as the amount ingested is prudent.

A unique device for carrying water is the CamelBak Hydration System, which allows you to sip continuously from an over-the-shoulder delivery tube.

If the urine becomes darkened or scant, fluid requirements are not being met. ("Cloudy," or unclear, urine may indicate a different sort of problem, such as protein in the urine or a urinary tract infection.) As a general rule, people outdoors should consume at least 3 quarts (liters) of fluid each day to replenish that lost through urination, exhaled moisture, skin evaporation, and defecation. With moderate activity, this should be increased to at least 4 to 5 quarts. Do not rely on thirst as an absolute guide to fluid requirements. In general, merely quenching thirst does not

adequately replace fluid losses in heat stress or high-altitude conditions. It is possible to sweat up to 3 quarts per hour when exercising in extremely hot and humid conditions. During heavy exertion in hot weather, consider drinking at least a quart of liquid per hour.

With a normal diet, there is no need to take salt tablets. Electrolyte requirements can be met with food salted to taste. Electrolyte- and sugar-enriched drinks, such as Gatorade or Gatorade G2, should be used when normal meals cannot be eaten or when sweating is excessive (during athletic training or military forced marching, for example). A home brew (see page 208) may be used if a Gatorade-type beverage is not available. Accelerade is a sports beverage that contains 15 grams of carbohydrate and 4 grams of protein per 8 fluid ounces. This combination may be muscle-sparing during periods of high exertion, in warm or cold weather. The normal daily diet may be safely supplemented during times of extreme sweating (greater than $\frac{1}{2}$ to 1 quart, or liter, per hour) with 5 to 10 g of sodium (normal daily dietary intake is 4 to 6 g; most adults would be fine with 1 to 3 g) and 2 to 4 g of potassium. Supplemental salt is advised when weight loss from sweating exceeds 5 lb (2.3 kg) in a single session, particularly early in the acclimatization period when salt losses in sweat are great. Consume 0.5 g ($\frac{1}{4}$ tsp) sodium chloride (table salt) with a pint (473 mL) of water for each pound (0.45 kg) of weight loss over 5 lb. If large quantities of electrolytes are lost and not replaced (for instance, if large quantities of water are consumed without salt), a person can become quite ill. Hyponatremia (low serum [in the blood] sodium) is a condition in which excessive water drinking occurs without salt replenishment. Symptoms include nausea, vomiting, headache, weakness, fatigue, muscle weakness, difficulty with balance and walking, confusion, fluid in the lungs (shortness of breath and coughing, sometimes productive of frothy and/or blood-tinged sputum), and seizures. The condition may become fatal. Similarly, salt without water can be harmful. Salt tablets can be very irritating to the stomach, and should not be used unless salt-containing solutions are not available. Coffee, tea, and alcohol-containing beverages cause increased fluid loss through excessive urination (diuretic effect) and should be avoided.

2. Be watchful of the very young and very old. Their bodies do not regulate body temperature well and can rapidly become too hot or too cold. Do not bundle up infants in warm weather.
3. Stay in shape. Obesity, lack of conditioning, insufficient rest, and ingestion of alcohol and/or illicit drugs all contribute to an increased risk for heat illness. The herb ephedra contains ephedrine, which is reputed to enhance athletic performance; however, it increases metabolic rate and has caused many cases of heat illness and deaths.
4. Condition yourself for the environment. Gradual increased exposure to work in a hot environment for a minimum of an hour a day for 8 to 10 days will

allow an adult to acclimatize. Children require 10 to 14 days. More time spent in the heat hastens the process. Acclimatization is manifested as increased sweat volume with a decreased electrolyte concentration (more efficient sweating), greater peripheral blood vessel dilatation (more efficient heat loss), lowered heart rate, decreased skin and rectal temperatures during exercise, increased water and salt conservation by the kidneys, and enhanced metabolism of energy supplies. Eat potassium-rich vegetables and fruits, such as broccoli and bananas. Do not restrict fluid intake during acclimatization. On the contrary, it is necessary to increase fluid intake to accompany increased sweat volume.

5. Wear clothing appropriate for the environment. Dress in layers so that you can add or shed clothing as necessary. Clothing should be lightweight and absorbent. Wear a loose-fitting broad-brimmed hat to shield yourself from the sun, but do not wear a hat if you do not need protection from the sun. Do not wear plastic or rubber sweat suits in the heat.
6. Towel off your face and scalp frequently, because 50% of sweating occurs from these areas. Remove headgear when possible to allow evaporation from the head. Allow the scalp, face, and upper torso access to air circulation, since these are the major areas of sweating and therefore provide opportunity for sweat evaporation.
7. Keep out of the sun on a hot day. Resting on hot ground increases heat stress; the sun can heat the ground by more than 40°F (22.2°C) above the air temperature. If you must lie on the ground, dig a shallow (a few inches, or centimeters) trench to get down to a cooler surface.
8. Avoid taking drugs that inhibit the sweating process (such as atropine, antispasmodics, anti-motion-sickness), diminish cardiac output (beta blockers), disrupt certain features of physiological activity (antidepressants, antihistamines), increase muscle activity (hallucinogens, cocaine), or promote dehydration (diuretics).
9. To find water in the desert, look for green plants. Near the ocean shore, drinkable water may be found below a sandy or gravel surface at an elevation above seawater. Look for green plants. Water may be found at the foot of cliffs that have become waterfalls after a rainstorm or flood. Look under rocks, even if the surface appears dry.
10. If you are prone to fainting episodes, particularly of the vasovagal type, learn to recognize the warning symptoms that occur before fainting, which include weakness, feeling light-headed, sweating, blurred vision, nausea, headache, warm or cold feeling, yawning, nervousness, and growing pale. You may also feel “out of body” or disoriented. If any of these occur and you recognize that you might faint, immediately try to lie face down on the ground, so that you do not fall, and allow gravity to assist in bringing blood from your limbs back to the central circulation and your brain.



WILDLAND FIRES

The wilderness adventurer or casual hiker in a forest or timbered park may find himself face to face with a wildland fire. This section will discuss high-risk situations, survival techniques, and medical considerations. Review the sections on burns (see page 108), lightning injuries (see page 395), heat illness (see page 322), and inhalation injuries (see page 114) as well.

HIGH-RISK SITUATIONS

The risk for a wildland fire is increased under certain environmental conditions. Pay heed to posted warnings of fire hazard, and do not venture into the woods unprepared to escape. Be particularly cautious when:

1. There are drought conditions. Low humidity, higher air temperatures, and gusty winds create dry fuel for a fire.
2. You are in an area rich with abundant fuel, such as dead grass, pine needles, shrubs, fallen trees, and the like.
3. You travel through gullies, in canyons, along steep slopes, or in other regions where wind and fuel are ideal for rapid advance of an established fire.
4. Fires have occurred recently in the vicinity.
5. You cannot see the main fire and are not in contact with anyone who can.
6. Terrain and fuels make escape to safety zones difficult.

STANDARD FIRE ENCOUNTER PRINCIPLES

1. Have advance knowledge of weather conditions and forecasts before undertaking an expedition. Do not travel in hazardous regions in times of high fire risk. Local ranger stations are the best source of information. *Never plan an extended journey without leaving an itinerary with the proper authorities.* In the event of a fire, try to maintain communication with firefighters or other rescuers.
2. At every campsite, take a few moments to prepare a plan for an evacuation, with at least two escape routes. Be certain that everyone understands the routes.
3. If a fire is in the area, pay attention to it, so that you will know what the fire is doing. Obtain current information on fire status. If there is any chance that it can involve your party, *get out early*.
4. If you see smoke or fire at a distance, post a lookout to watch for any changes that might indicate increased danger.

5. In all situations, stay calm and act with authority. Give orders concisely and be sure that they are understood. Base all of your actions on the current and expected behavior of the fire.
6. Do not attempt to fight the fire unless you have provided for safety first. Your first responsibility is to evacuate all potential victims and provide necessary first aid. In general, it is best to leave fire fighting to professionals. If you become a fire fighter, provide for safety first. Determine safety zones and escape routes.
7. Do not sleep near a wildland fire. If the wind and fire direction change, you may be overcome with smoke and unable to escape.

WHAT TO DO WHEN CAUGHT IN A WILDLAND FIRE

1. Try not to panic. This is difficult, but if anything will save your life, it will be a clear head.
2. Don't move downhill toward a fire, because fires have a tendency to run uphill.
3. Unless the path of escape is clear, don't start running. Conserve your strength, and seek the flank of the fire. Continually observe changes in speed and direction of the fire and smoke to choose travel away from fire hazards. Be alert, keep calm, and avoid injury from rolling or falling debris.
4. Enter a burned area, particularly one with little fuel (grass or low shrubs). Although there is a chance that the area might burn again, you are better off here than in an area of fresh fuel. If you have to cross the fire line, cover your skin as well as possible, take a couple of deep breaths, and dash through the lowest flames (less than 3 ft, or 92 cm, deep and where you can see through them). If smoke is dense, crawl along the ground for better air and visibility.
5. If you cannot enter a burned area, ignite grass or other fine fuels between you and the fire edge. After this area burns, step into it and cover your exposed skin with clothing or dirt. This is not an effective technique in areas of heavier fuels.
6. Try to avoid breathing smoke. Hold a moistened cloth over your mouth. If the air is very hot, use a dry cloth (dry heat is less damaging to the lungs than is steam). If you have a choice of clothing, cover your skin with closed-toe shoes, a long-sleeved cotton or wool shirt, cotton or wool pants, a hat, and gloves.
7. Seek refuge from the radiant heat. Take shelter in a trench, in a pond, behind rocks, or in a stream, vehicle, or building. Do not climb into elevated water tanks, wells, caves, or any other place where you might be trapped or quickly use up the available oxygen.
8. If all else fails and you cannot escape the advancing flames, lie face down on the ground and cover your exposed skin as best possible. This is better than standing or kneeling.

9. If you are near a vehicle, and there is no route for escape, it is better to stay in the vehicle than to run from the fire. Try to position the vehicle in an area of little natural vegetation. Avoid driving through dense smoke. Turn off the headlights and ignition. Roll up the windows, close the air vents, and shield yourself from the radiant heat by covering up with floor mats or hiding under the dash. Stay in the vehicle as long as possible (it is rare for a gasoline tank to explode, and it takes a minute or two for the vehicle to catch on fire). Do not be overly alarmed if the vehicle rocks, or if smoke and sparks enter the vehicle. When the fire passes, cover your nose and mouth with a moistened cloth to avoid inhaling fumes from burning plastics and paint. Use urine if no other liquid is available.
10. If you are in a building and a fire is approaching, attach hoses to external water fixtures to achieve as much water spray coverage as possible. Place lawn sprinklers on the roof or use the hoses to soak down the roof. Put a ladder outside that will reach the roof. Locate and position buckets, rakes, axes, and shovels. Soak down shrubs and combustible foliage within 20 ft (6 m) of the building. If you have time, also do the following:
 - Close windows, vents, doors, and blinds. Remove combustible drapes and window dressings. Close doors inside the house to prevent drafts.
 - Turn off the gas at the meter. Turn off all pilot lights (heater, range, oven, and so on). Turn off any propane tanks.
 - Open the fireplace damper and close the fireplace screens.
 - Place water in containers to fight the fire. A wet mop may be used to extinguish sparks and embers.
 - Turn on a light in each room (for visibility if smoke accumulates).
 - Move flammable furniture away from windows and sliding glass doors.
 - Move flammable patio furniture indoors or far away from the building.
 - Keep all of your pets in one room.
 - If you have a car or truck, back it into the garage or park it in an open space facing the direction of escape. Shut the doors and roll up the windows. Leave the key in the ignition. Close the garage door(s) and windows, but leave them unlocked. Disconnect any automatic garage door opener.

HOW TO REPORT A FIRE

If you suspect a wildland fire, *immediately* report it to local fire protection authorities. You should be prepared to give your name and location, the location of the fire, a description of the fire (flames, color, smoke), and a list of any people in the area, with their most exact locations.

CREATING A DEFENSIBLE SPACE

Everyone now must consider how best to safeguard their homes and property against an encroaching wildfire. At the wildland-urban interface, human dwellings are juxtaposed against the wilderness. As opposed to the man-made fire breaks imposed by living in the city, there is often scant protection out “in the country.” The recommendations that follow are applicable in an urban setting as well, but are much more important in a wildland setting:

1. Use fire-resistant external construction materials, particularly for the roof, where embers may fall. Wooden shakes are highly flammable. Keep the gutters clean of combustible materials.
2. Remove combustible materials from close proximity to the dwelling. This includes piles of wood, flammable refuse, leaf litter, dead limbs, and piles of slash. Dry underbrush within stands of trees close to a dwelling serves as tinder for a fire.
3. If landscaping is flammable, maintain it as far as possible from the dwelling, so that it does not provide an easy flame path to your home. The further that combustible landscaping is located from the at-risk buildings, the better. A recommended minimum distance is 30 to 50 feet. In addition, create paths and openings that allow firefighters easy access to the dwelling.
4. Keep all trees and shrubs pruned of dead limbs and leaves. Do not allow large trees, dead or alive, to overhang your home. Maintain a green lawn if the lawn is adjacent to your home. Do not allow grass to grow tall and become dry, so that it can easily burn.
5. To block embers from entering your home, use metal screens over vents and other openings. Otherwise, they can enter and ignite the inside of the dwelling.

MEDICAL CONSIDERATIONS

The three most common medical problems in a wildland fire situation are burns (see page 108), smoke inhalation (see page 115), and dehydration (see page 207), followed by heat illness (see page 322) and poison ivy or oak exposure (see page 232). Anyone exposed to the constant and intense heat of a forest fire should consume at least a pint to a quart ($\frac{1}{2}$ to 1 liter) of fluid per hour.

CARBON MONOXIDE POISONING

In general, there is not a shortage of oxygen in the region of an outdoor fire, so long as there is adequate ventilation. However, in an enclosed space, oxygen may be rapidly depleted as toxic gases and smoke accumulate. This can occur when people cook inside a tent or snow cave, particularly with gasoline or

kerosene as fuel. The most commonly inhaled toxin is carbon monoxide, which is the tasteless, odorless, and colorless product of incomplete combustion. Carbon monoxide binds to hemoglobin (the oxygen-carrying pigment in red blood cells) with 200 times the affinity of oxygen. Thus, a human victim suffers from markedly diminished delivery of oxygen to all organ systems. Symptoms of carbon monoxide intoxication include the following:

Mild (10% level measured in the blood). Decreased exercise tolerance, decreased ability to concentrate, headache, nausea.

Moderate (20% level). Severe headache, vomiting, poor coordination, decreased vision, decreased hearing, shortness of breath.

Severe (30% level). Confusion, lethargy.

Catastrophic (40% to 60% level). Fainting, unconsciousness, gasping respirations, seizures, shock, death.

If a person is suspected to have inhaled any toxic gas, he should be moved to fresh air as soon as possible, and have oxygen (see page 431) administered at a flow rate of 5 to 10 liters per minute by facemask. Anyone overcome with smoke inhalation should be rapidly transported to a hospital. Be prepared to manage the airway (see page 22). The definitive treatment for severe carbon monoxide poisoning is treatment with oxygen in a hyperbaric chamber. If a person suffers from carbon monoxide poisoning and is allowed to breathe normal air, it takes 4 to 5 hours for half of the carbon monoxide in his system to be eliminated. This elimination time ("half-life") is decreased to 45 to 60 minutes if he breathes 100% oxygen through a facemask, however, and can be decreased to 15 to 20 minutes if oxygen is breathed under 3 atmospheres of pressure in a hyperbaric chamber.



ALTITUDE-RELATED PROBLEMS

Altitudes of 8,000 to 14,000 ft (2,438 to 4,267 m) are attained regularly by skiers, hikers, and climbers in the continental United States. Outside the United States, mountain climbers may reach altitudes of up to 29,029 ft (8,848 m) (Mount Everest). Appendix 2 (page 512) lists common conversion numbers from feet to meters and vice versa.

Most difficulties at high altitude are a direct result of the lowered concentration of oxygen in the atmosphere. Although the percentage of oxygen in the air is relatively constant at about 20%, the absolute amount of oxygen decreases with the declining barometric pressure. Thus, at 19,030 ft (5,800 m) there is half the barometric pressure, and therefore half the oxygen, that is available at sea level. A person transported suddenly to this altitude without time to acclimatize or without the provision of supplemental oxygen would probably lose consciousness; sudden transport to the summit of Mount Everest (where the amount of inspired oxygen is 28% that at sea level) would cause rapid collapse and death. Although high-altitude illness is common with rapid ascent above 8,200 ft (2,500 m), the most common range for severe altitude illness is 11,500 to 18,000 ft (approximately 3,500 to 5,500 m). Above 18,000 ft (5,500 m), altitude is considered extreme, and a human deteriorates rather than adapts. Commercial airplanes are pressurized to an atmospheric pressure equivalent to that at 8,200 ft (2,500 m) above sea level.

Habitation at high altitude causes a generalized decreased tolerance for exercise and physical stress. To a certain extent, humans can adapt to high altitude and become more efficient in the oxygen-poor environment. The prevention of altitude-related disorders is best accomplished by gradual acclimatization to the lowered oxygen content of atmospheric air. In this process, you increase the rate and depth of your breathing; this delivers more oxygen to and removes more carbon dioxide from your body. This, along with changes that occur in kidney function, causes your blood to become more alkaline, which allows it to take up and deliver more oxygen to your tissues. Resting heart rate gradually increases. Over time, red blood cell production is increased, and your heart and skeletal muscles become more efficient.

PREVENTION OF ALTITUDE-RELATED DISORDERS

Avoid direct or sudden ascent to a sleeping altitude above 9,020 ft (2,750 m). Acclimatization requires gradual exposure to altitude, with a rate of ascent not to exceed 1,500 ft (457 m) per day at altitudes above 8,000 ft (2,438 m). Rest days at a constant altitude are essential at heights above 10,000 ft (3,048 m). Acclimatization is achieved by adhering to a schedule of ascent:

For any climb above 9,843 ft (3,000 m), spend an initial 2 to 3 nights at 8,202 to 9,843 ft (2,500 to 3,000 m) before proceeding higher. The first day should be a rest day. Do not sleep at an altitude more than 984 ft (300 m) above the previous night's sleeping altitude. If anyone shows signs of altitude-related illness, spend additional time at this altitude. Do not ascend to sleep at a higher altitude if you have any symptoms of high-altitude illness.

For any climb above 13,000 ft (3,962 m), all members of the party should add 2 to 4 days for acclimatization at 10,000 to 12,000 ft (3,048 to

3,658 m). Subsequent climbing should not exceed 1,500 ft (457 m) per day. A rest day every 2 to 3 days is advised, along with an extra night for acclimatization with any ascent of 2,000 ft (609 m) or more. The party should sleep at the lowest altitude that does not interfere with the purpose of the expedition, and should sleep no higher than 1,312 to 1,968 ft (400 to 600 m) above the sleeping altitude of the previous night. The aphorism is “Climb high—sleep low.” After a person has acclimatized by adhering to a schedule of slow ascent, it is important to remember that even a few days at low altitude may cause the adjustments to disappear, so that a person is once again susceptible to altitude illness, particularly high-altitude pulmonary edema (HAPE).

In addition, the drug acetazolamide (Diamox) has proven to be useful in stimulating breathing, diminishing the sleep disorder associated with acute mountain sickness (AMS; see page 341), facilitating the body's normal adjustment to high altitude, and thus improving nocturnal oxygenation. It is administered in a dose of 125 to 250 mg twice a day beginning 24 hours before ascent, and continued for a period of 2 days; within this period, the initial physiological acclimatization process should become operative. It may also be given as a 500 mg sustained-action capsule every 24 hours, with perhaps fewer side effects. Acetazolamide should be used if an ascent will be unavoidably rapid.

Children who have previously suffered from acute mountain sickness may benefit from acetazolamide, which should be administered in a dose of 5 mg/kg (2.2 lb) of body weight per day, in two divided doses, up to 125 mg per day. Diamox has a diuretic (increased urination) effect, so that it is extremely important to drink sufficient fluids to prevent dehydration. Fluid losses are generally greater at high altitude, so do not rely on thirst as a gauge of adequate fluid intake. Drink enough to keep the urine clear and light colored. *Diamox is no substitute for proper acclimatization!*

One study indicated that administration of inhaled salmeterol, a drug that affects transport of sodium and water in cells, may help decrease the risk of HAPE. The application of this finding to current recommendations for prevention and treatment is yet to be fully determined.

When you're traveling at high altitudes, avoid the use of alcohol, stay warm, keep out of the wind, avoid exhaustion, and eat regularly to avoid weight loss. A diet relatively high in carbohydrates may be preferable to one high in fat and protein. Avoid the use of alcohol or any drugs for sleep during the first few days at altitude. Disturbed (poor quality, interrupted) sleep is common at high altitude. Acetazolamide, 125 mg by mouth at bedtime, diminishes the “periodic breathing” associated with sleep disturbance and therefore improves oxygenation, resulting in improved sleep quality. If insomnia is severe *after the acclimatization process has occurred*, zolpidem (Ambien) 5 to 10 mg, temazepam (Restoril) 10 to 15 mg, or zaleplon (Sonata) 5 to 10 mg by mouth may be used with caution under the guidance of personnel extremely experienced with high-altitude medical syndromes. A sleeping aid drug may be used in combination with acetazolamide.

It is not known if sleep apnea contributes to AMS or HAPE. However, a person with sleep apnea should be extremely cautious when traveling at high altitude. Findings suggestive of sleep apnea include the following: daytime—excessive sleepiness, feeling tired on awakening, fatigue, irritability, difficulty with simple tasks, and shortness of breath; nighttime—loud snoring, witnessed episodes of diminished or absent breathing, poor sleep, frequent awakening, frequent urination at night, and bedwetting.

Since oxygen is transported in red blood cells, it is advisable to avoid being anemic at high altitude. Iron-deficiency anemia is common in women, related to menstrual bleeding. If this is recognized, it should be corrected under the supervision of a physician with the administration of ferrous sulfate 300 mg per day; note that a side effect is constipation.

A pregnant woman who wishes to travel to high altitude should be certain that she has a normal pregnancy (e.g., normal blood pressure, no abnormal bleeding, placenta in proper position as determined by ultrasound if necessary). There is a possible increased risk for dangerous hypertension associated with pregnancy (preeclampsia) at high altitude. Proper acclimatization is essential. Try to keep the sleeping altitude no higher than 10,000 ft (3,048 m) and never above 12,000 ft (3,658 m).

In addition to the effects of less oxygen available at high altitude, mountaineers are subjected to other environmental hazards. Temperature decreases with altitude by an average of 11.7°F (6.5°C) per 3,280 ft (1,000 m). Ultraviolet light penetration increases approximately 4% to 6% per 984 ft (300 m) gain in altitude, which increases the risk for sunburn, skin cancer, and snowblindness. Sunlight reflecting off glaciers absent a cooling wind can transfer intense radiant heat. The dry air and rapid breathing predispose to dehydration.

Physical fitness, while desirable for mountaineering, does not protect against high-altitude illness. This cannot be overemphasized. It is, of course, good to be in excellent physical condition, but this does not substitute in any way for proper acclimatization.

In terms of preexisting conditions and the risk for high-altitude illness, here are some other general guidelines:

Probably no extra risk: extremes of age, obesity, diabetes, stable condition (e.g., no ongoing angina) after coronary artery bypass surgery, mild chronic obstructive pulmonary disease (COPD), controlled asthma, normal (low-risk) pregnancy, controlled high blood pressure, controlled seizure disorder, psychiatric disorder, cancer, inflammatory diseases

Caution: moderate COPD, congestive heart failure, sleep apnea, worrisome irregular heart rhythms, recurrent episodes of angina, sickle cell trait, cerebrovascular diseases, abnormal lung circulation, uncontrolled seizure disorder, radial keratotomy

High risk: sickle cell anemia with history of crises, severe COPD, pulmonary hypertension, poorly controlled congestive heart failure

If a person suffers from any chronic condition, he should clear any travel of an extreme nature (high-altitude, cold, hot, exertion) with a physician and become educated on potential problems and solutions.

HIGH-ALTITUDE PULMONARY EDEMA

Pulmonary edema is excess fluid in the lungs, either in the lung tissue itself or in the space normally used for gas exchange (oxygen for carbon dioxide). Fluid in the lungs renders them unable to perform their normal task, and thus the victim cannot get enough oxygen.

High-altitude pulmonary edema (HAPE) usually occurs in an unacclimatized individual—typically a male—who rapidly ascends to an altitude that exceeds 8,000 ft (2,438 m), particularly if heavy exertion is involved. Prior traditional physical conditioning is not a factor; many cases involve young, previously healthy individuals. If the victim exercises above 8,000 ft (2,438 m) but sleeps at a lower altitude (such as 6,000 ft, or 1,829 m), his risk for developing HAPE is much less.

Symptoms begin 1 to 3 days after arrival at high altitude. They include shortness of breath, cough, weakness, easy fatigue (especially when walking uphill), and difficulty sleeping. Signs of acute mountain sickness (AMS; see page 341) are often present. As greater amounts of fluid accumulate in the lungs, the victim develops drowsiness, severe shortness of breath, and rapid heart rate; his initial dry and gentle (“soft”) cough produces white phlegm and then blood (pink, frothy sputum—a late sign); he exhibits confusion and cyanosis (bluish discoloration of the skin, particularly noticeable in the nail beds and lips). If you place an ear to the victim’s chest, you may hear crackling or gurgling noises. The symptoms worsen at night. Rapidly, the victim becomes extremely agitated, disoriented, and sweaty; he is in obvious extreme respiratory distress. Confusion, collapse, and coma follow. The victim may show a fever of up to 101.3°F (38.5°C).

As soon as the earliest signs of HAPE are present, the victim should be evacuated (carried, if necessary) to a lower altitude at which there were previously no symptoms. Such warning signs include rapid heart rate (greater than 90 to 100 beats per minute at rest), weakness, shortness of breath, cough, difficulty walking, inability to keep up, and poor judgment. Maximum rest is advised. The definitive treatments are descent and the administration of oxygen; if it is available, oxygen at a flow rate of 4 to 6 liters per minute should be administered by facemask (see page 431). Improvement is rarely noted until oxygen is administered or descent of at least 1,000 to 2,000 ft (304 to 608 m) is accomplished. If the victim improves, diminish the flow rate of oxygen to 2 to 4 liters per minute to conserve supplies.

In no case should a victim be left to descend by himself. Always have a healthy person accompany him. If the victim must be carried down, he should be kept in a sitting position, if possible. Keep him warm, as well.

Have the victim inhale albuterol or salmeterol from a metered dose inhaler according to the directions. The administration of fluid pills (diuretics) is controversial and should be done only under strict medical supervision, as should the administration of morphine.

Some aid stations in high-altitude regions are equipped with an inflatable pressure bag (such as a “Gamow bag”) large enough to enclose a human. This is used to simulate conditions at lower altitude and may be used to treat moderate or severe high-altitude illness. The cylinder-shaped Gamow container is a small, portable hyperbaric chamber that can be pressurized with a foot pump to 2 lb (0.9 kg) per square inch, which simulates a descent of approximately 5,248 ft (1,600 m); the exact equivalent of descent depends on the altitude at which the bag is deployed. The victim should be placed in the bag for a minimum of 2 hours. In addition, oxygen from a tank can be administered to the victim by facemask (see page 431) within the bag.

A drug that physicians are using successfully to treat HAPE is nifedipine, which lowers obstructive pressure in the pulmonary arterial circulation (which carries deoxygenated blood from the heart through the lungs). The first dose is 10 mg chewed, and then swallowed. This is followed by 10 mg every 4 to 6 hours, or 30 mg extended-release preparation (Adalat CC) every 12 to 24 hours. The dose in children for HAPE is 0.5 mg/kg (2.2. lb) of body weight (to a maximum dose of 10 mg) by mouth every 8 hours. Since this drug is also used to treat high blood pressure, a side effect can be low blood pressure and dizziness, particularly if the victim is dehydrated. These particular side effects seem to be minimal when the extended-release preparation is used. Nifedipine has also been used successfully to prevent HAPE in subjects with a history of repeated episodes, but is not yet recommended for prevention in the general population. The dose for prevention is 20 to 30 mg of the extended-release preparation every 12 hours. Other drugs that have been suggested for prevention include acetazolamide 125 to 250 mg twice a day (or 500 mg sustained release once a day), inhaled salmeterol 2 puffs every 8 to 12 hours, tadalafil 10 mg every 12 to 24 hours, sildenafil 30 mg three times a day, and dexamethasone 8 mg every 12 hours beginning 2 days before high-altitude exposure.

Sildenafil (Viagra) 50 mg by mouth every 8 hours has been used to treat HAPE, because of its effect on lowering pressure in part of the circulation within the lungs.

Once a victim has been judged to suffer from any degree of HAPE, he should no longer be a candidate for high-altitude travel until cleared by a physician. Such a precaution does not include routine jet airplane transportation.

HIGH-ALTITUDE CEREBRAL EDEMA

High-altitude cerebral edema (HACE) is the medical term for a disorder (theoretically linked to brain swelling) that involves an alteration of mental status seen at high altitude, related to diminished atmospheric oxygen. It may be present in

someone who has worsened from acute mountain sickness (see below) or who is suffering from HAPE. Symptoms include headache (often throbbing), difficulty walking (loss of balance, inability to walk a straight line, staggering, or frank inability to walk), clumsiness, confusion, amnesia, difficulty in speaking, drowsiness, vomiting, and, in severe cases, blurred vision, blindness, unconsciousness, paralysis, and/or coma. Other symptoms may include mood changes, hallucinations, paralysis of an arm and/or leg, and seizures (rare). Victims are often gray or pale in appearance. Imbalance or the inability to walk heel to toe in a straight line is a very worrisome sign and should prompt immediate action to treat the victim. An extremely drowsy person may slip rapidly into a coma. “High-altitude headache” is often the first noxious symptom noted on exposure to high altitude, and may be the harbinger of acute mountain sickness (AMS—see below).

The treatment for HACE is immediate descent to an altitude below one at which the victim previously had no symptoms, and the administration of oxygen at a flow rate of 5 to 10 liters per minute by face mask or nasal cannula (tube) (see page 431). If the victim becomes severely ill, he should be brought (carried, if necessary, and preferably in the sitting position) to a lower altitude (below 5,000 ft, or 1,524 m). In addition, administration of the steroid drug dexamethasone (Decadron) 8 mg first dose, and then 4 mg every 6 hours until descent is accomplished, may be helpful. The pediatric dose of Decadron is 0.5 mg/kg (2.2 lb) of body weight for the first dose, followed by 0.15 mg/kg every 6 hours. Again, *never leave a potentially seriously ill person to fend for himself*. A victim of HACE or HAPE can deteriorate rapidly, and most will need to be transported down the mountain. As with HAPE, a Gamow bag can be used for treatment. Because the early symptoms of acute mountain sickness (see below) and HACE are similar, pay close attention to the condition of ill members of your climbing party.

ACUTE MOUNTAIN SICKNESS

Acute mountain sickness (AMS) is the most common altitude-related disorder. It affects those who ascend to altitudes above 8,200 ft (2,500 m) from below 4,921 ft (1,500 m) and are unable to keep pace with acclimatization. A person who is partially acclimatized may be stricken if he ascends rapidly to a higher altitude, overexerts, or uses sleep medication (which can be a respiratory depressant). Symptoms, which may be quite subtle in the beginning, are most commonly headache (in its mildest form sometimes called “high-altitude headache”), followed in incidence by fatigue, dizziness, and loss of appetite. Other symptoms include insomnia, nausea, vomiting, drowsiness, weakness, and apathy. Some people have described the suffering associated with AMS as similar to a hangover. Children are prone to nausea and vomiting as a manifestation of AMS. The lips and fingernails may have a blue discoloration (cyanosis) if HAPE is present.

The most common and disabling symptom of AMS is headache that typically occurs on the second or third day at high altitude and may be complicated by difficulty in walking (particularly if HAPE is present) and impaired memory. The headache is mild to severe, throbbing, in both temples or the back of the head, worse during the night and on awakening, and worsened by straining or bending over. Mild symptoms of HACE accompany AMS; they include decreased appetite, mood swings, and lack of interest in activity. Some victims complain of a deep inner chill. AMS is sometimes mistaken for a viral illness, such as the flu, or exhaustion or dehydration. Lassitude may be so severe that the victim is too apathetic to contribute to his or her own basic needs. The symptoms of AMS may be confused with dehydration, exhaustion, bacterial or viral infection, hypothermia, carbon monoxide poisoning, migraine headache, low blood sugar, transient ischemic attack or stroke, illicit drug ingestion, or psychiatric disease.

One hallmark of AMS, known as periodic breathing, is an alteration of the normal sleeping pattern. Sleep is fitful, with periods of wakefulness or disturbing dreams. The pattern of breathing becomes irregular, such that the sleeper has periods of rapid breathing (very deep breaths) alternated with periods of no breathing. The latter can be quite startling to the casual observer—intervals of 10 seconds may pass without a breath. Acetazolamide, 62.5 to 125 mg at bedtime, diminishes periodic breathing, improves oxygenation, and is safe to use as a sleeping aid. Insomnia from other causes may respond to short-acting drugs for sleep, such as zolpidem (Ambien) 5 to 10 mg, zaleplon (Sonata) 5 to 10 mg, triazolam (Halcion) 0.125 mg, or temazepam (Restoril) 10 to 15 mg, but as mentioned previously, these medications must be used with extreme caution in a person who is suffering incipient AMS, because any amount of respiratory depression might lead to decreased oxygenation. Also, sleep medication may mask the symptoms of HACE.

Treatment for AMS includes rest, adequate fluid intake to avoid dehydration, and mild pain medicine for the headache. Oxygen administration (0.5 to 1.5 liters per minute by nasal cannula or simple open facemask) may be effective for the headache, as might be acetaminophen or a nonsteroidal antiinflammatory medication, such as ibuprofen. The victim may be led to a lower altitude, preferably at least 1,640 to 3,281 ft (500 to 1,000 m) below that where symptoms began. However, many victims of AMS will adjust to the current altitude in a period from 12 hours to 3 to 4 days, and therefore may remain at a stable altitude if symptoms are mild. *In no case should a person attempt to climb to (or, particularly, sleep at) a higher altitude until the symptoms of AMS have completely subsided.* If symptoms worsen appreciably while a person remains at rest at a constant altitude, descent is indicated. With mild AMS, acetazolamide (Diamox) can be administered in a dose of 250 mg by mouth every 12 hours until symptoms diminish. The dose in children is 5 mg/kg (2.2 lb) of body weight per day, in two divided doses, up to 250 mg per day.

Prochlorperazine (Compazine) 10 mg by mouth or 25 mg by suppository can be given for nausea and vomiting, with the added benefit that it may stimulate the beneficial ventilatory (breathing) response that is triggered by a low oxygen content in the blood (associated with altitude and called the “hypoxic ventilatory response”). The dose in children older than 2 years of age is 0.4 mg/kg (2.2 lb) of body weight per day, by mouth or by oral suppository, in three or four divided doses. Promethazine (Phenergan) is fine as an alternative for adults, in a dose of 25 to 50 mg by mouth or suppository. Aspirin, acetaminophen, or ibuprofen may be given for headache. Avoid the use of alcohol or other respiratory depressants.

If an oxygen cylinder is available (see page 431), low-flow (0.5 to 1.5 liters per minute) oxygen by nasal cannula (tube) or facemask is particularly effective if used for sleep. This alone may be adequate to halt the progression of mild AMS and allow a victim to acclimatize without descent to a lower altitude. However, if this approach is taken, the victim should not be left alone until all symptoms of AMS have resolved. The victim who spends a few hours in a hyperbaric chamber, which simulates descent, will notice diminution of symptoms and benefit from hastened acclimatization. The “Gamow bag,” and other similar lightweight fabric pressure bags, are inflated by manual air pumps. Inflation at 2 pounds per square inch is roughly equivalent to a descent of 5,249 ft (1,600 m). A few hours of pressurization may have noticeable beneficial effect for many hours. To completely eliminate AMS, it is sometimes necessary to remain within the bag for 12 hours or more.

If AMS is moderate to severe and certainly if there is reason to suspect that HACE is developing (the victim wishes to be left alone or is becoming confused, cannot perform simple tasks such as eating and dressing, is vomiting, and cannot walk a straight line), administer dexamethasone as previously recommended for HACE. AMS can progress to HACE with coma in 24 hours.

Dexamethasone is used by some climbers to prevent AMS. Dexamethasone should not be used for routine prevention, because it does not enhance acclimatization, but rather masks symptoms. It may be useful for persons who are performing a rapid ascent and who cannot tolerate acetazolamide, but with extreme caution, as it does nothing to prevent HAPE and if descent is delayed and dexamethasone discontinued, the rebound effect can cause rapid onset of severe AMS or HACE. It may be used to treat AMS in a dose of 4 mg by mouth every 6 hours. It should be used for no more than 48 hours, during which time descent should be undertaken, from where acclimatization may proceed.

Ginkgo biloba administered in a dose of 80 to 100 mg by mouth twice a day has been recently suggested to reduce the incidence of AMS, and perhaps to be helpful as a therapy. Caution is advised in choosing a natural product that has a validated amount of active ingredient(s).

If symptoms of AMS worsen despite 24 hours of additional acclimatization and/or treatment, have the victim descend immediately to a lower altitude. A reasonable descent is a minimum of 2,500 to 3,000 ft (762 to 914 m).

OTHER DISORDERS OF HIGH ALTITUDE

High-Altitude Headache

The first unpleasant symptom of high-altitude exposure is often headache, which may or may not be a prelude to AMS (which would be accompanied by nausea, vomiting, fatigue, dizziness, or difficulty sleeping). It may be effectively treated with a nonsteroidal antiinflammatory drug (e.g., ibuprofen) or aspirin, but has been effectively treated with the drugs used to prevent AMS (acetazolamide and dexamethasone), antimigraine medication (such as sumatriptan [Imitrex]), or oxygen inhalation.

Fluid Retention

Swelling of the face, hands, and feet may occur after 4 to 10 days at increased altitude. Women are more commonly affected than are men, and they note puffiness of the hands, feet, eyelids, and face, particularly in the morning after a night's sleep or just before a menstrual period. Ten or more lb (4.5 kg) can be gained in fluid retention. The swelling persists for 1 to 3 days after return to lower altitude, and then spontaneously disappears (increased urination is noted at this time). The disorder is a nuisance, but of no real medical hazard. Salt intake should be controlled so as not to be excessive. Avoid fluid pills (diuretics), which promote dehydration and rarely reduce the swelling to any significant degree. These should only be used in the absence of AMS under the supervision of trained medical personnel. A person who retains fluid at high altitude should be examined for signs and symptoms of HACE and HAPE.

Visual Changes after Radial Keratotomy (RK)

Visual changes may occur at high altitude in persons who have undergone radial keratotomy (RK), in which 4 to 8 incisions are made in the cornea to cure nearsightedness. Perhaps because the cornea is now not as strong, or for other reasons yet to be determined, there may be a significant farsighted shift and corneal flattening, which cause blurred vision. This does not appear to be the case following photorefractive keratectomy (PRK) or laser-assisted in situ keratomileusis (LASIK). A person who has undergone RK should consider carrying "plus" glasses or goggles to correct an unexpected condition of farsighted vision.

High-Altitude Flatus Expulsion (HAFE)

High-altitude flatus expulsion (HAFE) is the spontaneous and unwelcome passage of increased quantities of rectal gas noted at high altitude. It may become an embarrassment but is of no true medical concern. Avoid foods

such as chili and beans that are known to induce flatulence at low altitudes, and show consideration for other members of the party in sleeping arrangements. If stricken, a traveler may benefit from chewable tablets of simethicone (Mylicon 80 mg) or simethicone 80 mg with activated charcoal 250 mg (Flatulex tablets) once or twice a day. Charcoal Plus is another simethicone-activated charcoal preparation.

Altitude Throat

Altitude throat (pharyngitis) is a sore throat caused by nasal congestion and mouth breathing during exertion at high altitudes. Because the air is dry and cold, the protective mucous coating of the throat is dried out and the throat becomes extremely irritated, with redness and pain. In general, this can be distinguished from a bacterial or viral infection (see page 195) by the absence of fever, swollen lymph glands in the neck, or systemic symptoms (fatigue, muscle aches, sweats, and the like). Prevention is difficult and treatment is only mildly satisfying. The victim should keep his throat moist by sipping liquids and sucking on throat lozenges or hard candies (Life Savers, for instance). As soon as convenient, nighttime breathing of warm humidified air should be instituted. Avoid anesthetic gargles, since they will mask the signs of a true infection. If the inside of the nose becomes dried out, this may be treated with topical ointment (e.g., bacitracin, mupirocin, or petroleum jelly).

High-Altitude Bronchitis

Most bronchitis has an infectious cause (see page 205). High-altitude bronchitis is more likely to be caused by relative hyperventilation of cold, dry air. This causes the secretions in the respiratory passages to thicken. The resulting airway irritation causes a persistent cough, which can cause coughing fits sufficiently severe to lead to rib fractures. Treatment consists of humidification of inspired air, which can be accomplished transiently by cautiously breathing steam, and over the longer term by breathing through a porous scarf or balaclava that allows retention of moisture and heat.

Snowblindness

See page 187.



SNAKEBITE

POISONOUS SNAKES

Two types of poisonous snakes are indigenous to the United States: pit vipers (rattlesnake, cottonmouth [water moccasin], copperhead) and coral snakes. Their distributions are as follows:

Northeast. Cottonmouth, copperhead, timber rattlesnake.

Southeast. Cottonmouth, copperhead, eastern diamondback rattlesnake, pygmy rattlesnake, eastern coral snake.

Central. Cottonmouth, copperhead, massasauga rattlesnake, timber rattlesnake, prairie rattlesnake.

Southwest. Cottonmouth, copperhead, pygmy rattlesnake, massasauga rattlesnake, northern black-tailed rattlesnake, prairie rattlesnake, sidewinder, Mojave rattlesnake, western diamondback rattlesnake, red diamondback rattlesnake, Texas coral snake, Sonoran coral snake.

Pacific Coast. Northern Pacific rattlesnake, southern Pacific rattlesnake, Great Basin rattlesnake, western diamondback rattlesnake, red diamondback rattlesnake, sidewinder, Mojave rattlesnake.

In the United States, 98% of venomous bites are from pit vipers. In addition, many “nonvenomous” species, such as colubrid (rear-fanged) snakes (including the red-neck keelback), are capable of producing venomous bites. There are no indigenous venomous snakes in Hawaii or Alaska.

Pit vipers are typified by rattlesnakes, which have a characteristic triangular head, vertical elliptical pupils (“cat’s eyes”), two elongated and hinged fangs in the front part of the jaw, heat-sensing (infrared-sensing) facial pits on the sides of the head midway between and below the level of the eyes and the nostrils, a single row of scales on the underbelly leading to the tail (not seen in nonpoisonous snakes), and rattles on the tail (Figure 179). The snake’s age is not determined by the number of rattles, since molting may occur up to four times a year. Because fangs are replaced every 6 to 10 weeks in the adult rattlesnake, bites may demonstrate from one to four large puncture marks. An adult pit viper can strike at a speed of 8 ft (2.4 m) per second. The rattlesnake may strike without a preliminary warning rattle.

Coral snakes are characterized by their color pattern, with red, black, and yellow or white bands encircling the body (Figure 180). A general rule is “red on yellow—kill a fellow (venomous); red on black—venom lack (nonvenomous).” The fangs are very short and fixed; the snakes have round pupils, and they bite with a chewing, rather than striking, action.

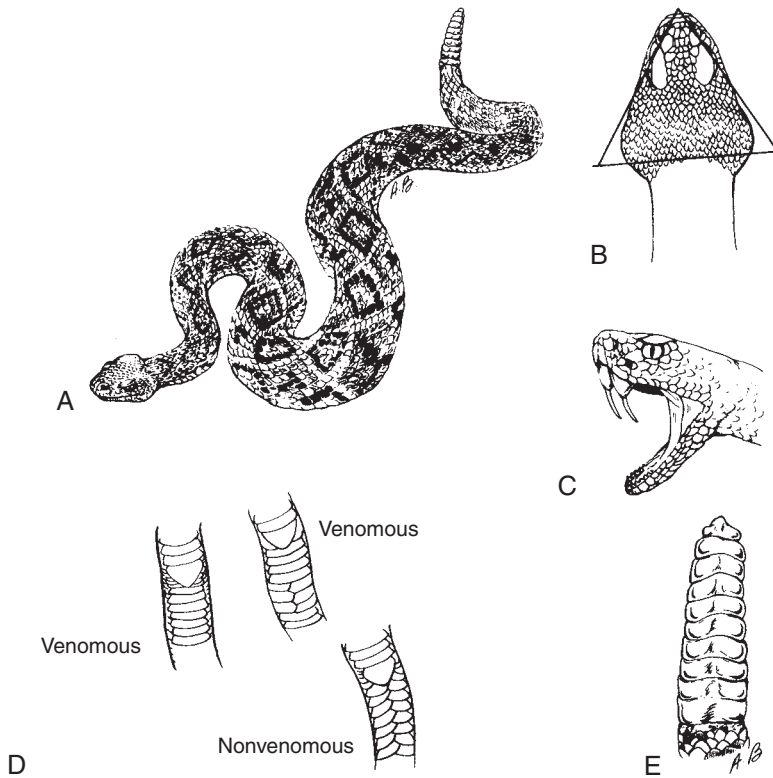


Figure 179. Rattlesnake. Typical rattlesnake appearance (A), with features of identification that include (B) triangular head, (C) hinged fangs, (D) single row of underbelly scales leading up to the anal plate, and (E) a rattle on the tail.

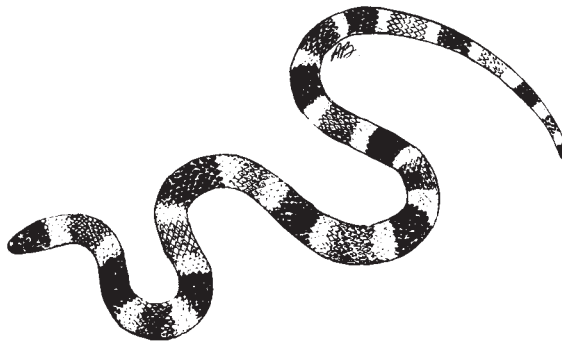


Figure 180. Coral snake.

Signs of Envenomation

Most snakebites do not result in envenomation, because the snake does not release venom, the skin is not penetrated, or the venom is not potent. Therefore, it is important to recognize the signs of envenomation, in order to avoid needless worry, evacuation, and improper therapy.

The most common signs of envenomation are as follows:

Pit Vipers

1. One or more fang marks. Most snakebites (venomous and nonvenomous) will demonstrate rows of markings from the teeth. In the case of venomous snakes, there will be one to four larger distinct markings from the elongated fangs that inoculate the victim with venom (Figure 181). Venomous snakebite wounds tend to bleed more freely than bites from animals and insects.
2. Burning pain at the site of the bite. *This may not be present with the bite of the Mojave rattlesnake.*
3. Swelling at the site of the bite. This usually begins within 5 to 10 minutes of envenomation and may become quite severe. *This may not be present with the bite of the Mojave rattlesnake.*
4. Numbness and tingling of the lips, face, fingers, toes, and scalp 30 to 60 minutes after the bite. This can also be present if the victim

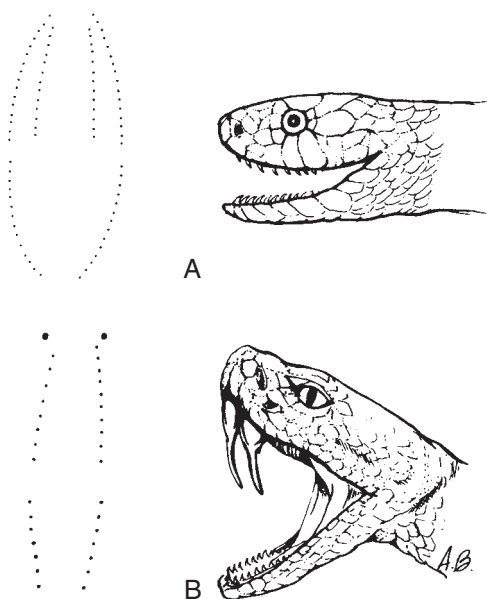


Figure 181. Snakebite patterns. **A**, Nonvenomous snake. **B**, Venomous snake.

hyperventilates with fear and excitement (see page 300). If a victim of a snakebite has immediate symptoms, these are likely to be due to hyperventilation.

5. Twitching of the mouth, face, neck, eye, and bitten extremity muscles 30 to 90 minutes after the bite.
6. Rubbery or metallic taste in the mouth 30 to 90 minutes after the bite.
7. Sweating, weakness, nausea, vomiting, and fainting 1 to 2 hours after the bite. Additional symptoms include chest tightness, rapid breathing rate (20 to 25 breaths per minute), rapid heart rate (125 to 175 beats per minute), palpitations, headache, chills, and confusion.
8. Bruising at the site of the bite. This usually begins within 2 to 3 hours. Large blood blisters may develop within 6 to 10 hours.
9. Difficulty breathing, increased bleeding (bruising, bloody urine, bloody bowel movements, vomiting blood), and collapse 6 to 12 hours after the bite.

Coral Snakes

1. Burning pain at the site of the bite may be present or absent. There is generally very little local swelling or bruising, and certainly much less than that seen with the bite of a pit viper.
2. Numbness and/or weakness of a bitten arm or leg within 90 minutes.
3. Twitching, nervousness, drowsiness, giddiness, increased salivation and drooling in 1 to 3 hours. Vomiting may occur.
4. Slurred speech, double vision, difficulty talking and swallowing, and impaired breathing within 5 to 10 hours.
5. Death from heart and lung failure.

Treatment of Snakebite

If a person is bitten by a snake that could be poisonous, act swiftly. *The definitive treatment for serious snake venom poisoning is the administration of antivenom. The most important aspect of therapy is to get the victim to an appropriate medical facility as quickly as possible.*

1. Don't panic. Most bites, even by venomous snakes, do not result in medically significant envenomations. Reassure the victim and keep him from acting in an energy-consuming, purposeless fashion. If the victim has been envenomed, increased physical activity may increase his illness by hastening the spread of venom. If the victim is hyperventilating from fear, manage according to the instructions on page 300.
2. Retreat out of the striking range of the snake, which for safety's sake should be considered to be the snake's body length (for pit vipers, it is actually approximately half the body length). A rattlesnake can strike at a speed of 8 ft (2.4 m) per second.

3. Locate the snake. If possible, identify the species. If you cannot do this with confidence (which is really only important for the Mojave rattlesnake and coral snake), one can photograph the snake using a digital camera. Do not attempt to capture or kill the snake, for fear of wasting time and perhaps provoking another bite. Never delay transport of the victim to capture a snake. If the snake is dead, take care to handle it with a very long stick or shovel, and to carry the dead animal in a container that will not allow the head of the snake to bite another victim (the jaws can bite in a reflex action for up to 90 minutes after death). If you are not sure how to collect the snake, it is best just to get away from it.
4. Splint the bitten body part, to avoid unnecessary motion. Allow room for swelling within the splint. Maintain the bitten arm or leg in a position of comfort. Remove any jewelry that could become an inadvertent tourniquet.
5. Transport the victim to the nearest hospital.
6. *Do not apply ice directly to the wound or immerse the part in ice water.* An ice pack placed over the wound (as one would do for a sprain) is of no proven value to retard absorption of venom, but may be useful for pain control. Application of extreme cold can cause an injury similar to frost-bite, and possibly lead to enough tissue loss to require amputation.
7. Application of the Extractor Pump (see Figure 204) is controversial. The manufacturer claims that if the device is applied according to the instructions provided, it can remove venom without the need for a skin incision. Animal research appears to refute this notion, and even to suggest that by using the device for a rattlesnake bite, it might cause concentration of tissue-toxic venom under the suction cup, leading to a more severe reaction. Until further notice, the Sawyer Extractor Pump is no longer recommended by snake bite experts.
8. If the victim is more than 2 hours from medical attention, and the bite is on an arm or leg, one may use the pressure immobilization technique (Figure 182): Place a 2 in \times 2 in (5 cm \times 5 cm) cloth pad ($\frac{1}{4}$ in, or 0.6 cm, thick) over the bite and apply an elastic wrap firmly around the involved limb directly over the padded bite site with a margin of at least 4 to 6 in (10 to 15 cm) on either side of the wound, taking care to check for adequate circulation in the fingers and toes (normal pulses, feeling, and color). An alternative method is to simply wrap the entire limb at the described tightness with an elastic bandage. The wrap is meant to impede absorption of venom into the general circulation by containing it within the compressed tissue and microscopic blood and lymphatic vessels near the limb surface. You should then splint the limb to prevent motion. If the bite is on a hand or arm, also apply a sling. It should be noted that this recommendation is controversial, in that some experts believe that localizing venom in a single area might lead to an increased chance for tissue damage.

An alternative to the pressure immobilization technique is a constriction band (*not* a tourniquet) wrapped a few inches closer to the heart than

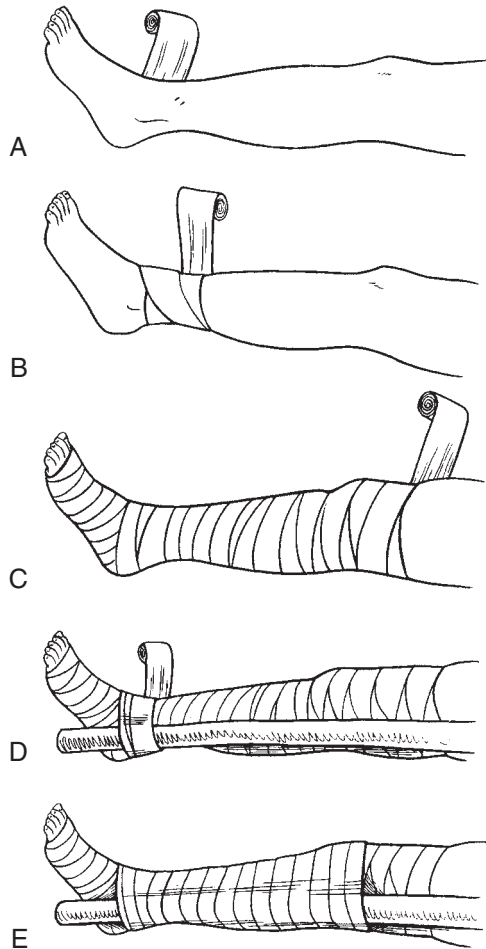


Figure 182. The pressure immobilization technique. **A**, Begin to wrap the limb directly over the bite site with an elastic bandage. **B**, Continue wrapping up the limb. **C**, Wrapped limb. **D**, Begin to apply a splint. **E**, Wrapped and splinted limb.

the bite marks on the bitten limb. This should be applied tightly enough to only occlude the superficial veins and lymph passages. To gauge tightness, the rescuer should be able to slip one or two fingers under the band, and normal pulses should be present. The band may be advanced periodically to stay ahead of the swelling. It is of questionable usefulness if 30 minutes have intervened between the time of the bite and the application of the constriction band (or pressure immobilization technique). Again, this recommendation is controversial, for the reasons mentioned in the previous paragraph.

9. *The impression of most snakebite experts is that incision and suction are of little value and probably should be abandoned.* It appears that little venom can actually be removed from the bite site. Furthermore, the incision may set the stage for inoculation of bacteria, infection, and a poorly healing wound. Mouth contact with the incision may cause a nasty infection that leaves a noticeable scar; there is also the risk of transmission of blood-borne disease to the rescuer.
10. “Snakebite medicine” (whiskey) is of no value and may actually be harmful if it increases circulation to the skin.
11. There is no scientific evidence that electrical shocks applied to snakebites are of any value. On the contrary, there are experiments that refute this concept.
12. The bite wound should be washed vigorously with soap and water, and the victim treated with dicloxacillin, erythromycin, or cephalexin.
13. If the victim is many hours or days from a hospital, assist him to walk out or arrange for a litter rescue, allowing frequent rest periods and adequate oral hydration. Splinting and positioning (e.g., elevating or lowering) the bitten part are secondary to any effort to reach a facility where antivenom can be administered.

Watch for an allergic reaction (see page 66) caused by the snakebite. This might cause the victim to be short of breath with or without an airway obstruction from swelling of the mouth, tongue, and throat. Once the victim is in the hospital, the severity of envenomation will be ascertained, and the victim treated with antivenom if necessary. Such therapy must be carried out under the supervision of a physician, because serious allergic reactions to antivenoms are possible.

Avoidance of Poisonous Snakes

1. Know the behavior and habitats of snakes in your area. Avoid the known habitats of poisonous snakes, such as rocky ledges and woodpiles.
2. Do not reach into areas that you cannot visually examine first. Walk on clearly marked trails, and use a walking stick to move suspicious objects. Do not reach blindly behind rocks. In flooded areas, avoid touching tree limbs and brush.
3. Wear adequate protective clothing, particularly loose-fitting bloused trousers and boots to cover your feet and lower legs.
4. Never hike alone in snake territory. Carry an elastic wrap and a SAM Splint (see page 74).
5. Avoid hiking at night in snake territory. Carry a flashlight and walking stick.
6. Do not handle snakes unless you know what you are doing. Some authorities mention that a defensive bite by a snake may release more venom than an offensive (feeding) bite. You can be bitten and envenomed by seemingly dead or nonvenomous snakes. Stay at least one body length away from a snake.

NONPOISONOUS SNAKES

Many snakes (for example, the gopher snake and king snake) are nonvenomous and do not create serious medical problems with a bite. However, identifying a snake from the bite puncture wounds is often extremely difficult for the amateur. Unless the snake can be positively identified as a nonvenomous species, the victim should be considered to have been bitten by a poisonous snake and managed appropriately. The snake may be very carefully captured or photographed for identification (see page 350). If the snake is absolutely known to be nonvenomous, the wound should be washed vigorously with soap and water, and the victim treated with dicloxacillin, erythromycin, or cephalexin.

Gila Monster and Mexican Beaded Lizard

The Gila monster (*Heloderma suspectum*) (Figure 183) and Mexican beaded lizard (*H. horridum*), which can grow to 14 in (35 cm) long, are found in the Great Sonoran Desert area of southern Arizona and northwestern Mexico. They possess grooved teeth and venom glands. Most envenomations occur when an animal bites and holds on, or when a tooth is shed into the bite wound. If the Gila monster holds on, the grip may need to be loosened by mechanical means or incision of the jaw muscles.

Symptoms of an envenomation include burning pain at the site of the bite, swelling of the bite wound, red or blue discoloration, nausea and vomiting, weakness, anxiety, rapid heart rate, and sweating. Low blood pressure is the most serious complication. Intense pain from the bite may last for 3 to 5 hours, and then subside after 8 hours.

The wound should be washed vigorously and all pieces of teeth removed. The victim should have his arm or leg splinted and should be transported to a

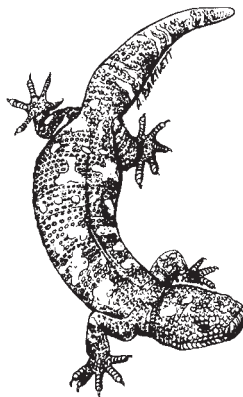


Figure 183. Gila monster.

hospital. Severe reactions are unusual; most victims recover uneventfully. Be prepared to treat the victim for shock (see page 60). Do not administer alcohol, stimulants, or narcotic pain medicines. Do not apply ice directly to the wound or immerse a bitten limb in ice water.

If it will be more than 24 hours before you can reach medical care, administer an antibiotic (cephalexin, erythromycin, or amoxicillin-clavulanate).



HAZARDOUS AQUATIC LIFE

In general, anyone who gets an infection following a wound acquired in a natural aquatic environment should be treated with an antibiotic to cover *Staphylococcus* and *Streptococcus* species (use dicloxacillin, erythromycin, or cephalexin), and a second antibiotic to cover *Vibrio* or *Aeromonas* species (use ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline). An infection from *Vibrio* or *Aeromonas* bacteria is more likely in deep puncture wounds, if there is a retained spine (such as from a stingray), and in people who suffer from an impaired immune system (diabetes, acquired immunodeficiency syndrome [AIDS], cancer, chronic liver disease, alcoholism, chronic corticosteroid therapy).

SHARKS

The jaws of the shark contain rows of razor-sharp teeth, which can bite down with extreme force (Figure 184). The result is a wound with loss of tissue that bleeds freely and can lead rapidly to shock (see page 60).

The basic management of a major bleeding wound is described on page 54. Even if a shark bite appears minor, the wound should be washed out and bandaged, and the victim taken to a doctor. Often, the wound will contain pieces of shark teeth, seaweed, or sand debris, which must be removed to avoid a nasty infection. Like other animal bites, shark bites should not be sewn or taped tightly shut, to allow drainage. This helps prevent serious infection. The victim should be started on an antibiotic to oppose *Vibrio* bacteria (ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline).

The skin of many sharks is rough, like sandpaper, and can cause a bad scrape. If this occurs, it should be managed similar to a second-degree burn (see page 108).

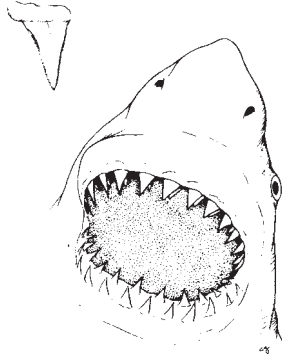


Figure 184. Jaws of the great white shark, with advancing rows of razor-sharp ripsaw teeth.

Shark Avoidance

1. Avoid shark-infested waters, particularly at dusk and after dark. Do not dive in known shark feeding grounds.
2. Swim in groups. Sharks tend to attack single swimmers.
3. When diving, avoid deep drop-offs, murky water, or areas near sewage outlets.
4. Do not tether captured (speared, for example) fish to your body.
5. Do not corner or provoke sharks.
6. If a shark appears, leave the water with slow, purposeful movements. *Do not panic or splash.* If a shark approaches you while you are diving in deep water, attempt to position yourself so that you are protected from the rear. If a shark moves in, attempt to strike a firm blow to the snout.
7. If you are stranded at sea and a rescue helicopter arrives to extract you from the water, exit the water at the earliest opportunity.

BARRACUDAS

Barracudas may bite victims and create nasty wounds with their long canine-like teeth (Figure 185). These wounds are managed similar to shark bites (see above). Because barracudas seem to be attracted to shiny objects, the swimmer, boater,

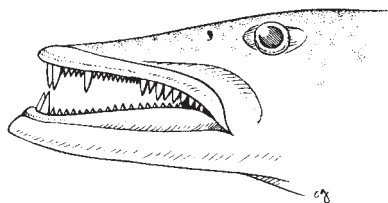


Figure 185. Barracuda, with large canine-like teeth.

or diver is advised to not wear bright metallic objects, particularly not a barrette in the hair or anklet dangled on a leg near the surface from a boat or dock.

MORAY EELS

Although they look quite ferocious, moray eels (Figure 186) seldom attack humans, unless provoked. They have muscular jaws equipped with sharp fanglike teeth, which can inflict a vicious bite. A moray tends to bite and hold on; in some instances, it is necessary to break the eel's jaws to get it to release.

A moray bite should be managed similar to a shark bite (see page 354). Even if the bite is very small, it should be examined by a physician, to be sure that all tooth fragments have been removed. If the bite is more than superficial and on the hand, on the foot, or near a joint, the victim should be started on an antibiotic (ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline) to oppose *Vibrio* bacteria. Avoid sewing or otherwise tightly closing a moray bite unless absolutely necessary.

SPONGES

Sponges handled directly from the ocean can cause two types of skin reaction. The first is an allergic type similar to that caused by poison oak (see page 234), with the difference that the reaction generally occurs within an hour after the sponge is handled. The skin becomes red, with burning, itching, and occasional blistering. The second type of reaction is caused by small spicules of silica from the sponges that are broken off and embedded in the outermost layers of the skin. This causes irritation, redness, and swelling. When large skin areas are involved, the victim may complain of fever, chills, fatigue, dizziness, nausea, and muscle cramps.

Because it is difficult to tell precisely which type of skin reaction has occurred, if a person develops a rash after handling a sponge, undertake the following therapy:

1. Soak the affected skin with white vinegar (5% acetic acid) for 15 minutes. This may be done by wetting a gauze pad or cloth with vinegar and laying it on the skin.

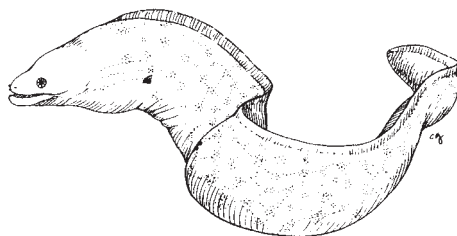


Figure 186. Moray eel.

2. Dry the skin, and then apply the sticky side of adhesive tape to the skin and peel it off. This will remove most sponge spicules that are present. An alternative is to apply a thin layer of rubber cement or a commercial facial peel, let it dry and adhere to the skin, and then peel it off.
3. Repeat the vinegar soak for 15 minutes or apply rubbing (isopropyl 40%) alcohol for 1 minute.
4. Dry the skin, and then apply hydrocortisone lotion (0.5% to 1%) thinly twice a day until the irritation is gone. Do not use topical steroids before decontaminating with vinegar; this might worsen the reaction.
5. If the rash worsens (blistering, increasing redness or pain, swollen lymph glands), this may indicate an infection, and the victim should be started on an antibiotic to oppose *Vibrio* bacteria (ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline). If the rash is persistent but there is no sign of infection, a 7-day course of oral prednisone in a tapering dose (for a 150 lb, or 68 kg, person, begin with 70 mg and decrease by 10 mg per day) may be helpful. Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

JELLYFISH

Jellyfish is the term commonly used to describe an enormous number of marine animals that are capable of inflicting a painful, and occasionally life-threatening, sting. These include fire coral, hydroids, jellyfish (including sea wasps), and anemones. The stings occur when the victim comes into contact with the creature's tentacles or other appendages, which may carry millions of microscopic stinging cells ("cnidocytes"), each cell equipped with a toxin-laden microscopic stinging apparatus. Depending on the species, size, geographic location, time of year, and other natural factors, stings can range in severity from mild burning and skin redness to excruciating pain and severe blistering with generalized illness (nausea, vomiting, shortness of breath, muscle spasms, low blood pressure, and so on). Broken-off tentacles that are fragmented in the surf or washed up on the beach can retain their toxicity for months and should not be handled, even if they appear to be dried out and withered.

The dreaded box jellyfish (*Chironex fleckeri*) (Figure 187) of northern Australia and the Indo-Pacific contains one of the most potent animal venoms known.

A sting from one of these creatures can induce death in minutes from cessation of breathing, abnormal heart rhythms, and profound low blood pressure (shock). A sting from the Irukandji (*Carukia barnesi*) causes a syndrome of muscle spasm (back pain), sweating, nausea and vomiting, high blood pressure, and perhaps death.

Be prepared to treat an allergic reaction following a jellyfish sting! (See page 66.)

The following therapy is recommended for all unidentified jellyfish and other creatures with stinging cells, including the box jellyfish, Portuguese man-of-war



Figure 187. Indo-Pacific box jellyfish (sometimes called sea wasp).

(“bluebottle”) (Figure 188), Irukandji, fire coral (Figure 189), stinging hydroid, sea nettle, and sea anemone (Figure 190):

1. If the sting is thought to be from the box jellyfish (*Chironex fleckeri*), immediately flood the wound with vinegar (5% acetic acid). Keep the victim as still as possible. Continually apply the vinegar until the victim can be brought to medical attention. If you are out at sea or on an isolated beach, allow the vinegar to soak the tentacles or stung skin for 10 minutes before you attempt to remove adherent tentacles or further treat the wound. In Australia, surf lifesavers (lifeguards) may carry antivenom, which is given as an intramuscular injection at the first-aid scene. The pressure immobilization technique is no longer recommended as a therapy for jellyfish stings.

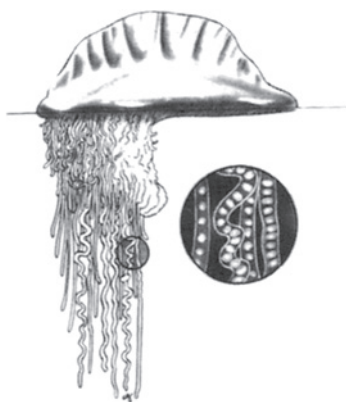


Figure 188. Portuguese man-of-war (“bluebottle”), with a close-up of stinging cells located on the tentacles.



Figure 189. Fire coral.



Figure 190. Sea anemone.

2. For all other stings, if a topical decontaminant (vinegar or isopropyl [rubbing] alcohol) is available, pour it liberally over the skin or apply a soaked compress. (Some authorities advise against the use of alcohol on the theoretical grounds that it has not been proven beyond a doubt to help. However, many clinical observations support its use. Since not all jellyfish are identical, it is extremely helpful to know ahead of time what works for the stingers in your specific geographic location.) Vinegar may not work as well to treat sea bather's eruption (see page 236); a better agent may be a solution of papain (such as unseasoned meat tenderizer—see below for precaution about duration of therapy). For a fire coral sting, citrus (e.g., fresh lime) juice that contains citric, malic, or tartaric acid may be effective. Topical lidocaine 4% may effectively numb a jellyfish sting, but may not lessen the envenomation.

Until the decontaminant is available, you can rinse the skin with seawater.

Do not rinse the skin gently with fresh water or apply ice directly to the skin, as these may worsen the envenomation. A brisk freshwater stream

(forceful shower) may have sufficient force to physically remove the microscopic stinging cells, but nonforceful application is more likely to cause the cells to fire, increasing the envenomation. A nonmoist ice or cold pack may be useful to diminish pain, but take care to wipe away any surface moisture (condensation) before the application. Recent observations from Australia suggest that hot (nonscalding) water application or immersion may diminish the sting of the Portuguese man-of-war from that part of the world. The generalization of this observation to treatment of other jellyfishes, particularly in North America, should not automatically be assumed, because of the fact that application of fresh water worsens certain envenomations.

3. Apply soaks of vinegar or rubbing alcohol for 30 minutes or until pain is relieved. Baking soda powder or paste is recommended to detoxify the sting of certain sea nettles, such as the Chesapeake Bay sea nettle. If these decontaminants are not available, apply soaks of dilute (quarter-strength) household ammonia. A paste made from unseasoned meat tenderizer (do not exceed 15 minutes of application time, particularly not on the sensitive skin of small children) or papaya fruit may be helpful. These contain papain, which may also be quite useful to alleviate the sting from the thimble jellyfish that causes sea bather's eruption (see page 236). Do not apply any organic solvent, such as kerosene, turpentine, or gasoline. While likely not harmful, urinating on a jellyfish, or any other marine, sting has never been proven to be effective.
4. After decontamination, apply a lather of shaving cream or soap and shave the affected area with a razor. In a pinch, you can use a paste of sand or mud in seawater and a clamshell.
5. Reapply the vinegar or rubbing alcohol soak for 15 minutes.
6. Apply a thin coating of hydrocortisone lotion (0.5% to 1%) twice a day. Anesthetic ointment (such as lidocaine hydrochloride 2.5% or a benzocaine-containing spray) may provide short-term pain relief.
7. If the victim has a large area involved (an entire arm or leg, face, or genitals), is very young or very old, or shows signs of generalized illness (nausea, vomiting, weakness, shortness of breath, chest pain, and the like), seek help from a doctor. If a child has placed tentacle fragments in his mouth, have him swish and spit whatever potable liquid is available. If there is already swelling in the mouth (muffled voice, difficulty swallowing, enlarged tongue and lips), do not give anything by mouth, protect the airway (see page 22), and rapidly transport the victim to a hospital.

To prevent jellyfish stings, an ocean bather or diver should wear, at a minimum, a synthetic nylon-rubber (Lycra [DuPont]) dive skin. Safe Sea Sunblock with Jellyfish Sting Protective Lotion (www.buysafesea.com), which is both a sunscreen and a jellyfish sting inhibitor, has been shown to be effective in preventing stings from many jellyfish species.

CORAL AND BARNACLE CUTS

Cuts and scrapes from sharp-edged coral and barnacles tend to fester and become infected wounds. Treatment for these cuts is as follows:

1. Scrub the cut vigorously with soap and water, and then flush the wound with large amounts of water.
2. Flush the wound with a half-strength solution of hydrogen peroxide in water. Rinse again with water.
3. Apply a thin layer of bacitracin or mupirocin ointment, or mupirocin cream, and cover with a dry, sterile, nonadherent dressing. If no ointment or dressing is available, the wound can be left open. Thereafter, it should be cleaned and redressed twice a day.

If the wound develops a poorly healing pus-laden crust, you can use wet-to-dry dressing changes to remove the upper nonhealing layer to expose healthy, healing tissue. This is done by putting a dry, sterile gauze pad over the wound (without any underlying ointment), soaking the gauze pad with saline or a dilute antiseptic solution (such as 1% to 5% povidone-iodine in disinfected water), allowing the liquid to dry, and then “brutally” ripping the bandage off the wound. The dead and dying tissue adheres to the gauze and is lifted free. The pink (hopefully), slightly bleeding tissue underneath should be healthy and healing. Dressings are changed once or twice a day. Use wet-to-dry dressings for a few days, or until they become nonadherent. At that point, switch back to the treatment in the above paragraph.

4. If the wound shows signs of infection (extreme redness, pus, swollen lymph glands) within 24 to 48 hours after the injury, start the victim on an antibiotic to oppose *Vibrio* bacteria (e.g., ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline), as well as an antibiotic to oppose *Staphylococcus* bacteria (e.g., dicloxacillin or cephalixin).

Coral poisoning occurs if coral cuts are extensive or the cuts are from a particularly toxic species. The symptoms include a coral cut that heals poorly or continues to drain pus or cloudy fluid, swelling around the cut, swollen lymph glands, fever, chills, and fatigue. An antibiotic (see step 4, directly above) should be started, and the victim seen by a physician, who may elect to treat the victim for a week or two with an oral corticosteroid.

SEA URCHINS

Some sea urchins are covered with sharp venom-filled spines (Figure 191) that can easily penetrate and break off into the skin, or with small pincer-like appendages (Figure 192) that grasp the victim and inoculate him with venom from a sac

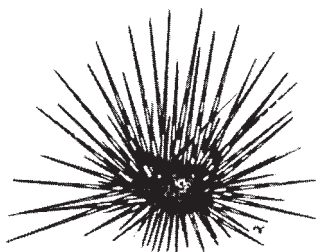


Figure 191. Spiny sea urchin.

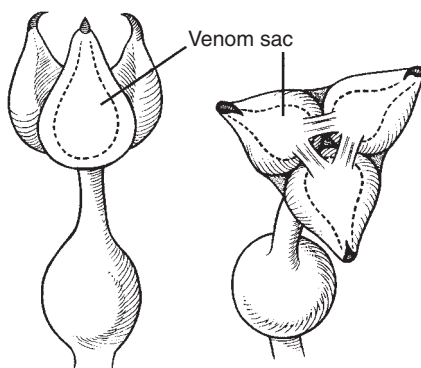


Figure 192. Sea urchin pincer with embedded venom sac.

within the pincer. Sea urchin punctures or stings are painful wounds, most often of the hands or feet. If a person receives many wounds simultaneously, the reaction may be so severe as to cause difficulty in breathing, weakness, and collapse. The treatment for sea urchin wounds is as follows:

1. Immerse the wound in nonscalding hot water to tolerance (110°F to 113°F, or 43.3°C to 45°C). This frequently provides pain relief. Administer appropriate pain medicine.
2. Carefully remove any readily visible spines. Do not dig around in the skin to fish them out—this risks crushing the spines and making them more difficult to remove. Do not intentionally crush the spines. Purple or black markings in the skin immediately after a sea urchin encounter do not necessarily indicate the presence of a retained spine fragment. Such discoloration is more likely dye leached from the surface of a spine, commonly from a black urchin (*Diadema* spp.). The dye will be absorbed over 24 to 48 hours, and the discoloration will disappear. If there are still black markings after 48 to 72 hours, a spine fragment is likely present.
3. If the sting is caused by a species with pincer organs, use hot-water immersion, and then apply shaving cream or a soap paste and shave the area.

4. Seek the care of a physician if you feel that spines have been retained in the hand or foot, or near a joint. They may need to be removed surgically, to minimize infection, inflammation, and damage to nerves or important blood vessels.
5. If the wound shows signs of infection (extreme redness, pus, swollen lymph glands) within 24 to 48 hours after the injury, or if the spine is felt to have penetrated into a joint, start the victim on an antibiotic to oppose *Vibrio* bacteria (e.g., ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline), as well as an antibiotic to oppose *Staphylococcus* bacteria (e.g., dicloxacillin or cephalexin).
6. If a spine puncture in the palm of the hand results in a persistent swollen finger without any sign of infection (fever, redness, swollen lymph glands in the elbow or armpit), it may become necessary to treat a 150 lb, or 68 kg, victim with a 7-day course of oral prednisone in a tapering dose (begin with 70 mg and decrease by 10 mg per day). Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

STARFISH

The crown of thorns starfish (*Acanthaster planci*) is a particularly venomous starfish found in tropical oceans worldwide (Figure 193). It carries sharp and rigid spines that may grow to 3 in (7.5 cm) in length. The cutting edges easily penetrate a diver's glove and cause a very painful puncture wound with copious bleeding and slight swelling. Multiple puncture wounds may lead to vomiting, swollen lymph glands, and brief muscle paralysis.

The treatment is similar to that for a sea urchin puncture (see page 362). Immerse the wound in nonscalding hot water to tolerance (110°F to 113°F or 43.3°C to 45°C) for 30 to 90 minutes. This frequently provides pain relief. Administer

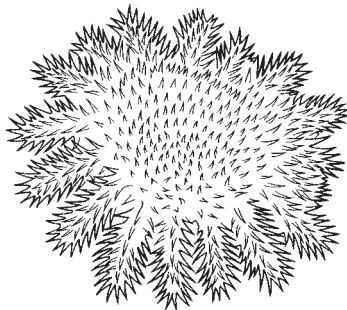


Figure 193. Crown of thorns starfish.

appropriate pain medicine. Carefully remove any readily visible spines. If there is a question of a retained spine or fragment, seek the assistance of a physician.

Other starfish, such as the rose star, can cause a skin rash. This may be treated with topical calamine lotion with 1% menthol or topical hydrocortisone 1% lotion.

CUCUMBERS

Sea cucumbers (Figure 194) are sausage-shaped creatures that produce a liquid called holothurin, which is a contact irritant to the skin and eyes. Because some sea cucumbers dine on jellyfish, they may excrete jellyfish stinging cells and venom as well. Therefore, anyone who sustains a skin irritation from handling a sea cucumber may benefit from the treatment for jellyfish stings described beginning on page 358. If the eyes are involved, they should be irrigated with at least a quart (liter) of water, and immediate medical attention should be sought. If the victim is out at sea, treat the eye injury as a corneal abrasion (see page 180).

BRISTLEWORMS

Bristleworms are small, segmented marine worms covered with chitinous bristles arranged in soft rows around the body (Figure 195). When a worm is stimulated, its body contracts and the bristles are erected. Easily detached, they penetrate skin like cactus spines and are difficult to remove. Some marine worms are also able to inflict painful bites.

The bite or sting of a marine worm may induce intense inflammation typified by burning sensation with a raised, red, and itchy rash, most frequently on the hands and fingers. Untreated, the pain is generally self-limited over the course of a few hours, but the redness and itching may last for 2 to 3 days. With multiple punctures, there may be marked swelling.

Remove all large visible bristles with tweezers. Then gently dry the skin, taking care to avoid breaking or embedding the spines farther into it. Apply a layer of adhesive tape, rubber cement, or a facial peel to remove the residual smaller

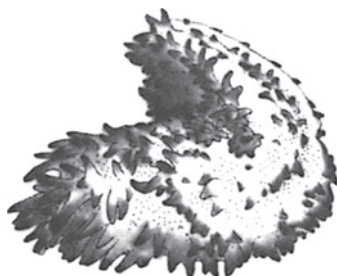


Figure 194. Sea cucumber.

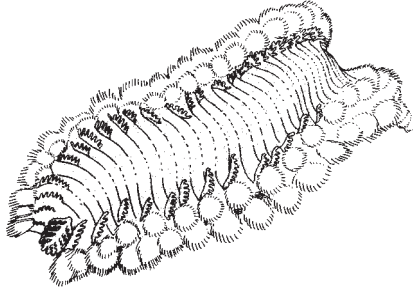


Figure 195. Bristleworm.

spines. If the residual inflammation is significant, the victim may benefit from the administration of topical hydrocortisone 1% lotion.

CONE SNAILS (SHELLS)

Cone snails (shells) are beautiful, yet potentially lethal, cone-shaped mollusks that carry a highly developed venom apparatus, consisting of a rapid-acting poison that is injected by means of a dartlike, barbed tooth (Figure 196). The venom causes a mild sting (puncture wound) that initially is characterized by bee sting–like pain or, rarely, numbness and blanching. This is rapidly followed by numbness and tingling at the wound site, around the mouth and lips, and then all over the body. If the envenomation is severe, the victim is afflicted with muscle paralysis, blurred vision, and breathing failure. A sting can be fatal.

There is no antivenom for a cone shell envenomation. While many first-aid remedies (such as hot-water immersion, surgical excision of the sting site, and injection of a local anesthetic) have been recommended, the one that makes the most sense is the pressure immobilization technique (see page 350) to contain

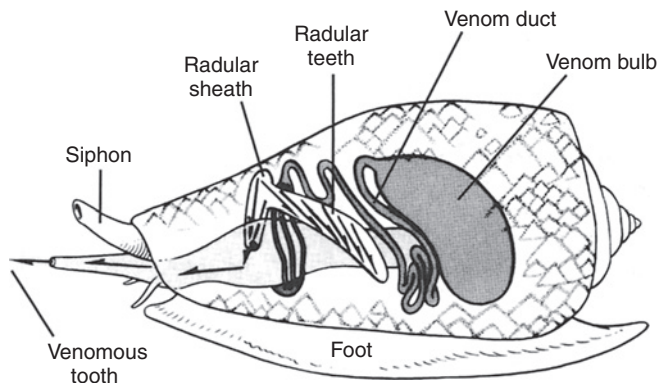


Figure 196. Cone snail, with a depiction of its venom apparatus.

the venom until the victim can be brought to advanced medical attention. Be prepared to offer the victim assistance for breathing (see page 29).

STINGRAYS

A stingray does its damage by lashing upward in self-defense with a muscular tail-like appendage, which carries up to four sharp, swordlike stings (Figure 197). The stings are supplied with venom, so that the injury created is both a deep puncture or laceration and an envenomation. The pain from a stingray wound can be excruciating and accompanied by bleeding, weakness, vomiting, headache, fainting, shortness of breath, paralysis, collapse, and occasionally, death. Most wounds involve the feet and legs, because unwary waders and swimmers tread on the creatures hidden in the sand. If a person is struck by a stingray, immediately do the following:

1. Rinse the wound with whatever clean water is available. Immediately immerse the wound in nonscalding hot water to tolerance (110°F to 113°F, or 43.3°C to 45°C). This may provide some pain relief. Generally, it is necessary to soak the wound for 30 to 90 minutes. Gently extract any obvious piece of stinger, unless it is felt to have penetrated into a location (e.g., chest, neck, abdomen, or groin) where it may have cut and is now occluding a large blood vessel, such as the heart or a major artery or vein. In such a case, leave the stinger in place, regardless of pain, and rush the victim to a hospital.
2. Scrub the wound with soap and water. Do not try to sew or tape it closed; doing so could promote a serious infection.
3. Apply a dressing and seek medical help. If more than 12 hours will pass before a doctor can be reached, start the victim on an antibiotic (ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline) to oppose *Vibrio* bacteria.
4. Administer appropriate pain medication.

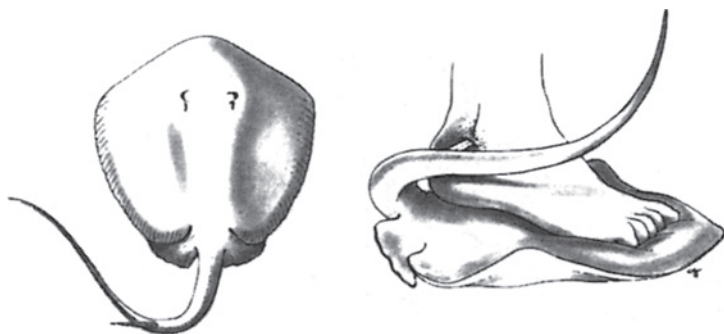


Figure 197. Stingray. The ray thrusts upward in self-defense with venom-laden spine(s) into the foot of an unwary victim.

Avoidance of Stingray Injuries

1. Always shuffle your feet when wading in stingray waters.
2. Always inspect the bottom before resting a limb in the sand.
3. Never handle a stingray unless you know what you are doing. Even seemingly “domesticated” stingrays, such as those at “Stingray City” off Grand Cayman Island in the British West Indies, have bitten victims with their grinding plate mouths, resulting in serious bite wounds, when handled.
4. Do not approach a stingray within striking distance of its barbed appendage.

CATFISH

Catfish sting their victims with dorsal and pectoral fin spines, which are charged with venom. When a fish is handled, the spines are extended and “locked” into position. The wound can be exceedingly painful, resembling the sting of a stingray. The treatment is the same as that for a stingray wound. Soaking the wound in nonscalding hot water to tolerance (110°F to 113°F, or 43.3°C to 45°C) may provide dramatic relief of pain.

Tiny South American catfish of the genus *Vandellia* are known as “urethra fish” in English. They can swim up the human urethra or other urogenital openings and lodge within the victim, where they extend short spines on their gill covers. This can be extremely painful. Nonsurgical treatment is the ingestion of megadose (1 to 2 g per day) ascorbic acid (vitamin C); when excreted in the urine, this supposedly slowly softens the spines and allows the fish to be excreted as well. Surgical removal is generally required because the victim cannot tolerate the discomfort caused by a retained urethra fish.

SCORPIONFISH

Scorpionfish include zebrafish (lionfish, turkeyfish) (Figure 198), scorpionfish, and stonefish. They possess dorsal, anal, and pelvic spines that transport venom from venom glands into puncture wounds. Common reactions include redness or blanching, swelling, and blistering (lionfish). The injuries can be extremely painful and occasionally life threatening. The treatment is the same as that for a stingray wound. Soaking the wound in nonscalding hot water to tolerance (110°F to 113°F, or 43.3°C to 45°C) may provide dramatic relief of pain from a lionfish sting, is less likely to be curative for a scorpionfish sting, and may have little effect on the pain from a stonefish sting, but it should be undertaken nonetheless, because the heat may perhaps destroy some of the harmful proteins contained in the venom. If the victim appears intoxicated or is weak, vomiting, short of breath, or unconscious, seek immediate advanced medical aid. Scorpionfish stings frequently require weeks or months to heal, and therefore require the attention of a physician. There is an anti-venom available to physicians to help manage the sting of the dreaded stonefish.

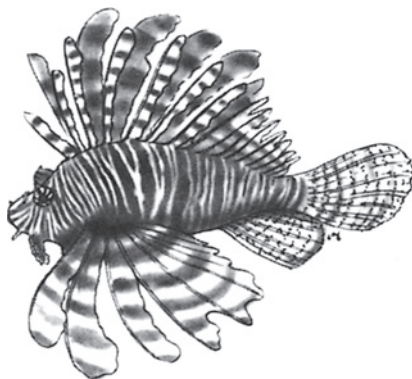


Figure 198. Lionfish (zebrafish).

SURGEONFISH

Surgeonfish are tropical reef fish that carry one or more retractable jackknife-like skin appendages on either side of the tail (Figure 199). When a fish is threatened, the appendage(s) is extended, where it serves as a blade to inflict a cut (Figure 200). The appendage may carry venom, which contributes to the pain.

Treatment is to soak the wound in nonscalding hot water to tolerance (110°F to 113°F, or 43.3°C to 45°C) for 30 to 90 minutes or until the pain is relieved, and then scrub vigorously to remove all foreign material. Watch closely for the development of an infection.

OCTOPUSES

Octopus bites are rare. A nonvenomous octopus bite causes a local irritation that does not require any special therapy, other than wound cleansing and observation for infection. However, a bite from the Indo-Pacific blue-ringed or spotted octopus inoculates the victim with a substance extremely similar to tetrodotoxin, one of the most potent poisons (also found in pufferfish—see page 371) found in nature.

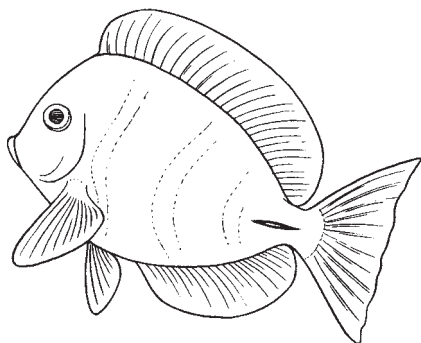


Figure 199. Surgeonfish.

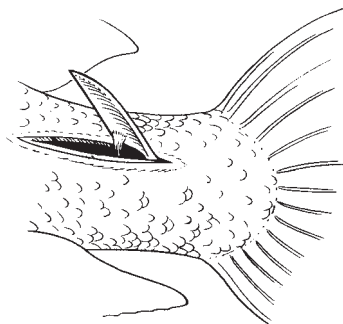


Figure 200. Surgeonfish tail, with blade extended.

Most victims are bitten on the hand or arm as they handle the creature or “give it a ride.” The bite consists of one or two small puncture wounds, and may go unnoticed. Otherwise, there is a small amount of discomfort, described as a minor ache, slight stinging, or pulsating sensation. Occasionally, the site is initially numb, followed in 5 to 10 minutes by discomfort that may spread to involve the entire limb. By far the most common local reaction is the absence of symptoms, a small spot of blood, or a tiny blanched area.

More serious symptoms develop within 15 minutes of the bite, and include numbness of the mouth and face, followed by blurred vision, difficulty speaking, incoordination, weakness, vomiting, muscle paralysis, and breathing failure. The victim may collapse quickly and die from inability to breathe.

First aid is the pressure immobilization technique (see page 350). Be prepared to provide artificial respiration (see page 29) until the victim can be brought to advanced medical attention. If oxygen (see page 431) is available, it should be administered by facemask at a flow rate of 10 liters per minute.

SEA SNAKES

Sea snakes are the most abundant reptiles on earth, though they are found only in the Pacific and Indian Oceans. They can attain a length of 9 ft (2.7 m) and are equipped with a paddle-like tail that allows them to swim forward and backward with considerable speed and agility (Figure 201).

A sea snake can bite a victim with two to four fangs. The venom is extremely toxic, and causes paralysis, destruction of red blood cells, and widespread muscle damage.

The diagnosis of sea snake envenomation is determined as follows:

1. Unless you are handling a snake (commonly, fishermen emptying nets), you must be in the water to be bitten by a sea snake. The animals cannot move easily on land and do not survive very long there. However, you must be cautious when exploring regions of tidal variation, particularly in mangrove vegetation or near inlets where snakes breed.
2. Sea snake bites rarely cause much pain at the bite site.

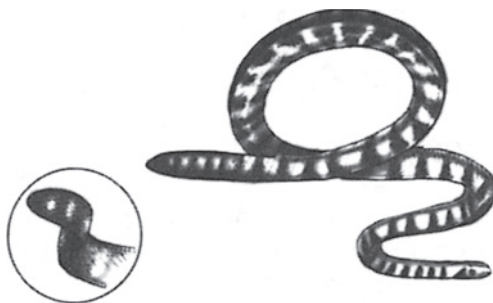


Figure 201. Sea snake, with paddle-shaped tail.

3. Fang marks. These are like pinholes and may number from one to four (rarely, up to 20).
4. If symptoms do not occur within 6 to 8 hours of the bite, significant poisoning has not occurred. The symptoms include weakness, paralysis, lockjaw, drooping eyelids, difficulty speaking, and vomiting. Later, the victim will develop darkened urine and difficulty breathing.

If a person is bitten by a sea snake, seek *immediate* medical attention, and immediately implement the pressure immobilization technique (see page 350). The definitive therapy is similar to that for a land snakebite—namely, administration in a hospital of the proper antivenom.

SKIN RASHES CAUSED BY AQUATIC PLANTS (SEAWEED DERMATITIS) OR CREATURES (SEA BATHER'S ERUPTION, SWIMMER'S ITCH)

See page 235.

POISONINGS FROM SEAFOOD

A number of fish and seafood products cause poisonings because they contain natural toxins or accumulated manmade toxins. For instance, in the past, the Food and Drug Administration has issued an advisory cautioning women who are or who might be pregnant, small children, and nursing mothers to not eat shark, swordfish, king mackerel, or tilefish because of accumulations of methylmercury.

Scombroid Poisoning

Scombroid poisoning is caused by improper preservation (inadequate refrigeration or drying) of fish in the family Scombridae, which includes tuna, mackerel, bonito, skipjacks, and wahoo. Nonscombroid fish that can also cause this

syndrome include mahi-mahi (dolphinfish), anchovies, sardines, and Australian ocean salmon. Most of these fish are dark fleshed. When they are not preserved properly, bacteria break down chemicals in the flesh to produce the chemical histamine, which causes an allergic-type reaction in the victim. Although the fish may have a peppery or metallic taste and “dull” appearance, they may also have normal color, flavor, and appearance. Tuna burgers may be seasoned and mask any abnormal taste.

Minutes after eating the fish, the victim becomes flushed, with itching, nausea and sometimes vomiting, diarrhea, low-grade fever, abdominal pain, and the development of hives (see page 238). Occasionally, a victim will develop low blood pressure and become weak and short of breath, sometimes with wheezing. The reaction is similar to that seen with monosodium glutamate (MSG) sensitivity (“Chinese food syndrome”). Treatment is the same as for an allergic reaction (see page 66). If the victim does not improve with diphenhydramine (Benadryl), he may benefit from cimetidine (Tagamet) 300 mg or fexofenadine (Allegra) 60 mg by mouth. Administer the chosen antihistamine every 6 to 8 hours until symptoms resolve—generally, within 12 to 24 hours.

Puffer Poisoning

Certain puffers (blowfish, globefish, swellfish, porcupinefish [Figure 202], and so on) contain tetrodotoxin, one of the most potent poisons in nature. These fish are prepared as a delicacy (fugu) in Japan by specially trained and licensed chefs. The toxin is found in the entire fish, with greatest concentration in the liver, intestines, reproductive organs, and skin. After the victim has eaten the fish, symptoms can occur as quickly as 10 minutes later or be delayed by a few hours. These include numbness and tingling around the

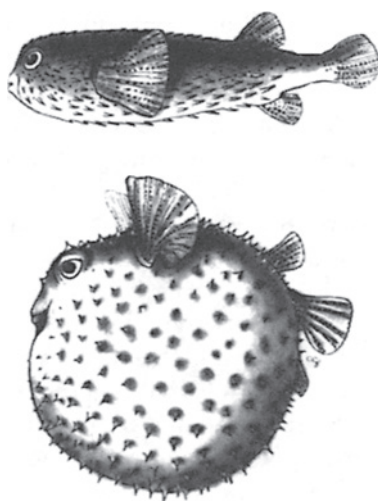


Figure 202. Porcupine (puffer) fish.

mouth, light-headedness, drooling, sweating, vomiting, diarrhea, abdominal pain, weakness, difficulty walking, paralysis, difficulty breathing, and collapse. Many victims die.

If someone is suffering from puffer poisoning, immediately transport him to a hospital. Pay attention to his ability to breathe, and assist his breathing if necessary (see page 29). Unfortunately, there is no antidote, and the victim will need sophisticated medical management until he metabolizes the toxin. Eating puffers, unless they are prepared by the most skilled chefs, is dietary Russian roulette.

Ciguatera Fish Poisoning

Ciguatera fish poisoning involves a large number of tropical and semitropical bottom-feeding fish that dine on plants or smaller fish that have accumulated toxins from microscopic dinoflagellates, such as *Gambierdiscus toxicus*. Therefore, the larger the fish, the greater the toxicity. The ciguatoxin-carrying fish most commonly ingested include the barracuda, jack, grouper, and snapper. Symptoms, which usually begin 15 to 30 minutes after the victim eats the contaminated fish, include abdominal pain, nausea, vomiting, diarrhea, tongue and throat numbness, tooth pain, difficulty walking, blurred vision, skin rash, itching, tearing of the eyes, weakness, twitching muscles, incoordination, difficulty sleeping, and occasional difficulty in breathing. A classic sign of ciguatera intoxication is the reversal of hot and cold sensation (hot liquids seem cold and vice versa), which may reflect general hypersensitivity to temperature. Unfortunately, the symptoms persist in varying severity for weeks to months. Victims can become severely ill, with heart problems, low blood pressure, deficiencies of the central and peripheral nervous systems, and generalized collapse.

Treatment is for the most part supportive, although certain drugs are beginning to prove useful for aspects of the syndrome. An example is intravenous mannitol for abnormal nervous system behavior or abnormal heart rhythms. These therapies must be undertaken by a physician. Prochlorperazine may be useful for vomiting; hydroxyzine or cool showers may be useful for itching. There are chemical tests (such as Cigua-Check Fish Poison Test Kit) to determine the presence of ciguatoxins in fish, but there is not yet a specific antidote. Anyone who displays symptoms of ciguatera fish poisoning should be seen promptly by a physician.

During recovery from ciguatera poisoning, the victim should exclude the following from his diet: fish, fish sauces, shellfish, shellfish sauces, alcoholic beverages, nuts, and nut oils.

Paralytic Shellfish Poisoning

Paralytic shellfish poisoning is caused by eating shellfish that contain concentrated toxins produced originally by certain planktons and protozoans in the ocean. These same microorganisms are responsible for the “red” (blue, brown,

white, black, and so on) tides that occur in warm summer months. The shellfish (such as California mussels, which are quarantined each year from May through October) dine on the microorganisms and concentrate the poison in their digestive organs and muscle tissues. Generally, crabs, shrimp, and abalone are safe to eat.

Minutes after eating contaminated shellfish, the victim complains of numbness and tingling inside and around his mouth, and of his tongue and gums. He soon becomes light-headed, weak, and incoherent, and begins to suffer from drooling, difficulty swallowing, incoordination, headache, thirst, diarrhea, abdominal pain, blurred vision, sweating, and rapid heartbeat. Even if a victim becomes paralyzed, he may continue to be aware of what is happening, unless he does not receive enough oxygen to the brain (because he stops breathing).

The victim of paralytic shellfish poisoning should be brought immediately to a hospital. If he is having trouble breathing, be prepared to assist him (see page 29).

Hallucinatory Fish Poisoning

Certain reef fish of the tropical Pacific and Indian Oceans carry heat-stable toxins in their head parts, brain, and spinal cords, and (to a lesser degree) in their muscles, or flesh. Typical species include surgeonfish, goatfish, mullets, sergeants major, damselfish, and rudderfish. The toxicity of the fish can vary with the season.

Symptoms occur within 90 minutes of ingestion, and include dizziness, numbness and tingling around the mouth and lips, sweating, weakness, incoordination, auditory and visual hallucinations, nightmares, shortness of breath, brief paralysis, and sore throat. People do not die from this affliction. Treatment is supportive. The victim should be observed closely to see that he does not injure himself by exercising bad judgment.

Anisakiasis

Anisakiasis is caused by penetration of the nematode *Anisakis simplex* worm larvae through the lining of the stomach. This occurs when someone eats raw or undercooked fish, such as sushi. The most common carriers, which serve as intermediate hosts via sea mammals, are mackerel, Pacific herring and cod, coho salmon, hake, anchovies, squid, silvergray and yellowtail rockfish, bocaccio, and, in rare cases, tuna.

Symptoms begin within 1 hour of eating the fish, and include severe pain in the upper abdomen, nausea, and vomiting. The victim may appear quite ill. Occasionally, he may have the symptoms of an allergic reaction.

If the worm(s) is not removed by a physician, who must do this physically through an endoscope passed through the esophagus into the stomach, it dies within a few days. However, implantation can initiate an abscess. Some worms

don't implant, but are coughed up, vomited up, or passed in the stool. If a worm crawls into the esophagus or throat, an unusual tingling feeling can develop.

A worm that passes through the stomach and implants in the intestine (up to 7 days after ingestion) causes abdominal pain, nausea, vomiting, diarrhea, and fever. It may penetrate completely through the bowel. Often an operation is performed for suspected appendicitis or intestinal cancer, only to discover the true cause of the victim's symptoms.

Unfortunately, there is no drug or purgative treatment that will eliminate the parasite once it has been ingested. It is either passed in the stool by the victim spontaneously or has to be physically removed, which can be as complicated as surgically removing a section of intestine.

To prevent this problem, any fish should be cooked to a temperature above 140°F (60°C) or frozen for 24 hours to -4°F (-20°C) before it is eaten. Smoking, marinating, pickling, brining, and salting may not kill the worms. A fish should be gutted as soon as possible after it is caught to prevent migration of the worms from its internal organs into its muscle tissue. An allergic reaction may still occur from eating properly preserved or cooked, but parasitized, fish.



INSECT AND ARTHROPOD BITES

BEES, SPIDERS, SCORPIONS, AND OTHER SMALL BITERS

Bees, Wasps, Hornets, and Ants

This group of insects includes honeybees, bumblebees, wasps, hornets, and yellow jackets; each possesses a stinger, which is used to introduce venom into the victim. Most stings occur on the head, neck, arms, and legs.

“Killer bees” are an Africanized race of honeybees created by interbreeding of the African honeybee *Apis mellifera scutellata* (brought for experiments into Brazil) with common European honeybees. The hazard from these bees is that they tend to be more irritable, sense threat at a distance greater than their European counterparts, swarm more readily, defend their nests more aggressively and stay agitated around the nest for days, and impose mass attacks on humans. The venom of an Africanized bee is not of greater volume or potency

than that of a European honeybee. However, the personality of the Africanized bees is such that they may pursue a victim for up to $\frac{2}{3}$ mile (1 km), and may recruit other attacking bees by the hundreds or thousands. A victim may be stung from 50 to more than 1,000 times; it is estimated that 500 stings achieves the lethal threshold. The bees are established in Arizona, New Mexico, and California, and unfortunately appear to be increasing their habitat as they adapt to colder temperatures.

The sting mechanism for a honeybee is composed of a doubly barbed stinger attached to a venom sac that pumps venom into the victim. When the bee attempts to escape after a sting, the stinger and sac remain in the victim (this kills the bee) and continue to inject venom. Thus, the honeybee can sting only once, whereas a wasp, with a smooth stinger that does not become entrapped, can sting multiple times, as can yellow jackets, hornets, and bumblebees.

Pain from a bee, wasp, or hornet sting is immediate, with rapid swelling, redness, warmth, and itching at the site of the sting. Blisters may occur. Sometimes the victim will become nauseated, vomit, and/or suffer abdominal cramping and diarrhea. If the person is allergic to the insect venom, a dangerous reaction may follow rapidly (within minutes, but occasionally delayed by up to 2 hours). This consists of hives, shortness of breath, difficulty breathing, swelling of the tongue, weakness, vomiting, low blood pressure, and collapse. People have swallowed bees (undetected in beverage bottles) and sustained stings of the esophagus, which are enormously painful.

A severe allergic reaction may follow the sting(s) of a fire (red) ant *Solenopsis invicta*, because it marches along the victim and leaves a trail of small, painful blisters. The fire ant hangs onto the victim's skin with pincers, and then uses a posterior stinger to deliver up to 8 stings while it pivots around. The bites and stings cause itching and swelling. A day or two after the ant bite, the fluid in the blister turns cloudy or white, and a small sterile pustule develops. This may continue to be painful and itch for a week or more. Harvester ants generally produce less severe reactions.

Treatment for Insect Sting

1. Be prepared to deal with a severe allergic reaction (see page 66). If the victim develops hives, shortness of breath, and profound weakness, and appears to be deteriorating, *immediately* administer epinephrine. This is injected subcutaneously (see page 474) in a dose of 0.3 to 0.5 mL for adults and 0.01 mL/kg (2.2 lb) of body weight for children, not to exceed 0.3 mL. Epinephrine is available in allergy kits with instructions for use. *Anyone known to have insect allergies who travels in the wilderness should carry epinephrine.* Take particular care to handle preloaded syringes carefully, to avoid inadvertent injection into a finger. When administering an injection, *never* share needles between people.

The drug is available in preloaded syringes in certain allergy kits, which include the EpiPen autoinjector and EpiPen Jr. autoinjector (Dey), the

Twinject autoinjector (Verus: 0.3 mg or 0.15 mg doses; 2 doses per unit), and the Ana-Kit. Instructions for use accompany the kits. The EpiPen and Twinject epinephrine products are generally easier for laypeople to use, because they require less dexterity to accomplish injection with them. The Twinject autoinjector and Ana-Kit syringe are configured with enough epinephrine for a second (repeat) dose, which is sometimes necessary. The Twinject is a true autoinjector for the first dose; the second dose is delivered as a routine injection from a concealed syringe and needle.

For dosing purposes, the EpiPen and Twinject 0.3 mg autoinjector should be used for adults and children over 66 lb (30 kg) in weight. Children 66 lb and under should be injected with the EpiPen Jr. or Twinject 0.15 mg autoinjector.

2. Administer diphenhydramine (Benadryl) by mouth, 50 to 100 mg for an adult and 1 mg/kg (2.2 lb) of body weight for a child. This antihistamine drug may be used by itself for a milder allergic reaction. Topical antihistamine lotions or creams may be beneficial.
3. Stingers or pieces of stingers left in the skin should be removed as quickly as possible (Figure 203). It used to be taught that pulling the stinger out with fingers or forceps squeezed more venom into the victim, but this is currently not believed to be true. So, it is better to flick or pull a stinger and venom sac out of the skin of the victim using tweezers or your fingers than to waste precious time searching for a straight-edged object, such as a knife or credit card, to scrape away the stinger. Furthermore, crude scraping runs the risk of breaking off the stinger and leaving it embedded in the skin. An alternative is to try to pull out the stinger, then apply the Extractor device (Figure 204), if you are carrying one and it is available immediately after the sting has occurred.
4. Apply ice packs to the site of the sting.
5. Home topical remedies, such as aspirin, a 20% aluminum salt-containing preparation (including many household antiperspirants), or paste of baking

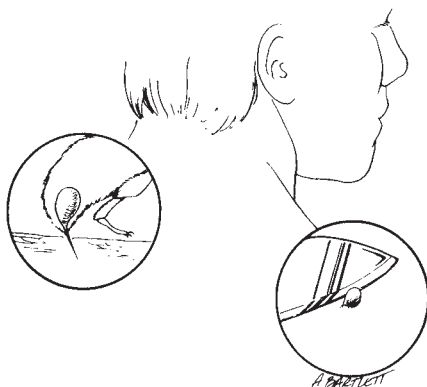


Figure 203. Honeybee sting. Because the venom sac is still attached to the stinger, both should be scraped or pulled free from the skin as soon as possible.

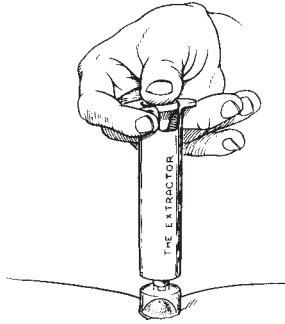


Figure 204. Application of the Extractor to a bee sting.

soda or papain-containing meat tenderizer (such as Adolph's unseasoned meat tenderizer) and water directly to the wound (for no more than 15 minutes), are of unproven value. Do not apply mud. The commercial product After Bite (Tender Corporation), a mixture of ammonium hydroxide and mink oil, is moderately effective for relief of pain and itching following insect bites, but will not abort an allergic reaction. StingEze liquid (Wisconsin Pharmacal) is a mixture of camphor, phenol, benzocaine, and diphenhydramine. This is a good agent to control itching and mild pain following any insect bite. Lidocaine 4% applied topically may help diminish discomfort.

6. If a person suffers an extensive skin and soft tissue reaction (swelling, itching, blisters), he may benefit from the administration of a corticosteroid, such as prednisone (60 mg by mouth day one, tapered by 10 mg per day over the next 5 days) or methylprednisolone (24 mg by mouth day one, tapered over the next 5 days).
7. If a person stung by an insect develops more than a mild to moderate local reaction, transport him to a hospital.
8. A bee sting in general does not pose a large risk for tetanus infection. Although deep punctures of other varieties deposit bacteria into the wound(s), where *C. tetani* can thrive in the absence of oxygen, a bee sting puncture isn't that deep. The stinger might transfer bacteria from the skin surface, wherein lies the greatest risk. If a person has been immunized within the past 5 years, it is unnecessary to get a Td (or Tdap) booster immunization. If it has been more than 5 years but less than 10 years since the last tetanus shot, a Td (or Tdap) booster is indicated. If it has been more than 10 years since the last tetanus shot, both a Td (or Tdap) booster and tetanus immune globulin are indicated, if you go by the book.

Avoidance of Stinging Insects

1. Store garbage, particularly fruit, at a distance from the campsite.
2. Remove (*carefully*) beehives and wasp nests from children's play areas.

3. Wear light-colored clothing. Dark-colored clothing is attractive to insects and may evoke a defensive (sting or bite) response. Keep shirt sleeves closed and tuck pants into boots. Wear light-colored socks.
4. Avoid wearing sweet fragrances that make you smell like a flower.
5. Do not anger bees or wasps. If confronted by a swarm, cover your face (eyes, nose, and mouth) and move rapidly from the area. If necessary, throw a blanket or towel over your head. Run if you must. Run through bushes or weeds to confuse the bees. Don't jump into a pool—the bees may wait for you and a severe allergic reaction from a sting while in the water may be extremely dangerous. Do not poke sticks or throw rocks into bee holes.
6. Avoid rapid or jerky movements near bees. Do not swat at them.

SPIDERS

Although more than 20,000 different species of spiders live in the United States, only a few pose any real hazard to humans. The troublemakers are those that bite and introduce venom from venom glands into the wound. The nature of the reaction depends on the type and quantity of venom.

Black Widow Spider

In the United States, the female black widow spider (*Latrodectus mactans*) is about $\frac{5}{8}$ in (15 mm) in body length, black or brown, and with a characteristic red (or orange or yellow) hourglass marking on the underside of the abdomen (Figure 205). The top side of the spider is shiny and features a fat abdomen that resembles a large black grape. The longest legs are directed toward the front. This species and other *Latrodectus* species are found scattered in rural regions, in barns, within harvested crops, and around outdoor stone walls. Some are arboreal.

The bite of the black widow spider is rarely very painful (usually more like a pinprick) and often causes little swelling or redness, although there can be a warm and reddened area around the bite. If much venom has been deposited, the victim develops a typical reaction well within an hour. Symptoms include

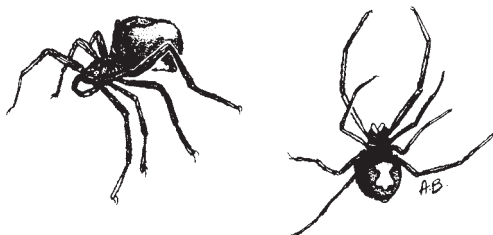


Figure 205. Female black widow spider with typical hourglass marking on the underside of the abdomen.

muscle cramps, particularly of the abdomen and back; muscle pain; muscle twitching; numbness and tingling of the palms of the hands and bottoms of the feet; headache; droopy eyelids; facial swelling; drooling; sweating; restlessness and anxiety; vomiting; chest muscle spasms, causing difficulty in breathing; fever; and high blood pressure. A man may develop a persistent penile erection (priapism). A small child may cry persistently. A pregnant woman may develop uterine contractions and premature labor.

Untreated, most people recover without help over the course of 8 hours to 2 days. However, very small children and elderly victims may suffer greatly, with possible death. There is an antivenom available to medical practitioners for treating the bite of the black widow spider. It is used for severe, sometimes life-threatening, symptoms.

Treatment for a Black Widow Spider Bite

1. Apply ice packs to the bite.
2. *Immediately* transport the victim to a medical facility.
3. Once the victim is in the hospital, the doctor will have a number of therapies to use, which include intravenous calcium solutions and muscle relaxant medicines for muscle spasm; antihypertensive drugs for elevated blood pressure; pain medicine; and, in very severe cases, antivenom to the venom of the black widow spider.
4. If you will be unable to reach a hospital within a few hours and the victim is suffering *severe* muscle spasms, you may administer an oral dose of diazepam (Valium), if you happen to be carrying it. The starting dose for an adult who does not regularly take the drug is 5 mg, which can be augmented in 2.5 mg increments every 30 minutes up to a total dose of 10 mg, so long as the victim remains alert and is capable of normal, purposeful swallowing. The starting dose for a child age 2 to 5 years is 0.5 mg; for a child age 6 to 12 years the starting dose is 2 mg. Total dose for a child should not exceed 5 mg; *never* leave a sedated child unattended.

Brown Recluse Spider

At least five species of recluse spiders are found in the United States. The brown recluse spider (*Loxosceles reclusa*) is the best known and found most commonly in the South and southern Midwest. However, interstate commerce has created habitats in many other parts of the country for the brown recluse and related species. The spider is brown, with an average body length of just under $\frac{1}{2}$ in (10 mm). A characteristic dark violin-shaped marking ("fiddleback") is found on the top of the upper section of the body (Figure 206). The brown recluse spider is found in dark, sheltered areas, such as under porches, in woodpiles, and in crates of fruit. It is most active at night. It commonly bites when it is trapped, but is not otherwise aggressive toward humans.

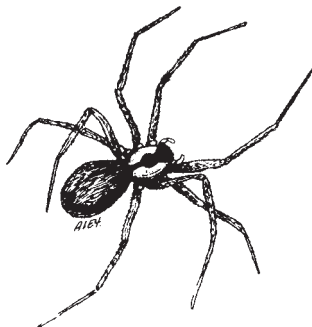


Figure 206. Brown recluse spider with typical violin-shaped marking on the top side of the cephalothorax.

The bite of the brown recluse spider may cause very little pain at first, or a sharp sting may be felt. The stinging subsides over 6 to 8 hours, and is replaced by aching and itching. Within 1 to 5 hours, a painful red or purplish blister sometimes appears, surrounded by a bull's-eye of whitish-blue (pale) discoloration, with occasional slight swelling. The red margin may spread into an irregular fried-egg pattern, with gravitational influence, such that the original blister remains near the uppermost part of the lesion. The victim may develop chills, fever, weakness, and a generalized red skin rash. Severe allergic reactions within 30 minutes of the bite occur infrequently. Over 5 to 7 days, the venom causes a violet discoloration and breakdown of the surrounding tissue, leading to an open ulcer that may take months to heal. If the reaction has been severe, the tissue in the center of the wound becomes destroyed, blackens, and dies.

A rare reaction is “systemic loxoscelism,” in which the venom binds to red blood cells and induces severe symptoms within 24 to 72 hours. These include a flu-like presentation with fever, chills, headache, fatigue, weakness, nausea, vomiting, muscle and joint aches, blood in the urine, yellow skin discoloration (jaundice), kidney failure, and even shock, seizures, and coma. This is more common in children and requires intensive medical therapy.

Treatment for a Brown Recluse Spider Bite

Because the bite of the brown recluse spider typically causes severe tissue destruction, the victim should see a physician, who will prescribe medicine or another therapy as soon as possible. In the meantime, apply cold packs to the wound for as long as is practical and administer an antibiotic (erythromycin, azithromycin, or cephalexin). Do not apply a heating pad or hot packs. Depending on the severity of the reaction, the doctor will either advise medicines or surgical excision of the bite. Dapsone, a drug used to inhibit certain cells that are part of the inflammatory response, has been used effectively. Hyperbaric oxygen therapy is recommended by some clinicians.

Until you receive other advice, treat the wound with a thin layer of mupirocin or bacitracin ointment, or mupirocin cream, underneath daily dressing changes. Do not apply topical steroids. Some persons have touted application of topical nitroglycerin, but there is not yet sufficient scientific evidence to routinely support this therapy.

Other Spiders

Other spiders that may produce painful bites and a small amount of local tissue breakdown include the tarantula, wolf spider, jumping spider, yellow sac spider, orb weaver, and hobo spider (*Tegenaria agrestis*). The bites should be treated with ice packs, pain medicine, and standard wound care.

Some tarantulas (Figure 207) carry hairs that can irritate the skin, eyes, and mucous membranes of humans. When the spider is threatened, it rubs its hind legs over its abdomen and flicks thousands of hairs at its foe. These hairs can penetrate human skin and cause swollen bumps, which can itch for weeks. If any hairs or hair fragments remain in the skin, they can be removed with repeated applications and peelings of sticky tape. After that, treatment is with an oral antihistamine and topical medication such as StingEze liquid. A topical antihistamine or corticosteroid preparation may provide some relief.

The hobo spider may cause a reaction similar to, but less severe than, a brown recluse spider. The bite wound should be treated accordingly (see page 380).

SCORPIONS

Scorpions are found in deserts and warm tropical climates, hidden under stones, fences, and garbage. In the United States, the most dangerous species is the nocturnal bark scorpion *Centruroides exilicauda*, which is found almost exclusively in the southwestern states and can be up to 2 in (5 cm) long. This yellowish-brown (straw-colored), solid or striped species is distinguished from other scorpions by its slender body and a small tubercle (telson) at the base of

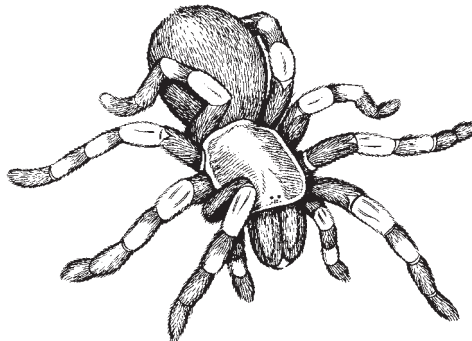


Figure 207. Tarantula.

its stinger (Figure 208). The sting is inflicted with the last segment of the tail, and it is immediately exquisitely painful; the pain is made much worse by tapping on the site of the injury. Other symptoms include excitement, increased salivation, sweating, numbness and tingling around the mouth, nausea, double vision, nervousness, muscle twitching and spasms, rapid breathing, shortness of breath, high blood pressure, seizures, paralysis, and collapse. A child under age 2 years is at particular risk for a severe reaction. Stings by nonlethal scorpion species are similar to bee stings.

If someone is stung by a scorpion, immediately apply an ice pack to the wound and immobilize the affected body part. Seek immediate care, particularly for stings of *C. exilicauda*.

To prevent scorpion stings, be careful when handling deadwood and working in piles of leaves. Clothing, shoes, bedrolls, and sleeping bags should be shaken out and inspected before use. *C. exilicauda* is fluorescent under an ultraviolet light (Wood's lamp or "black light") and can be spotted glowing green at night in this manner.

MOSQUITOES

Female mosquitoes bite humans in quest of a blood meal, to lay eggs. Because they breed in water, they are most frequently found in marshy, wetland, or wooded areas. Although many tend to swarm at dusk, different species feed at different times. The insects are attracted to host odors (long-range), exhaled carbon dioxide (midrange), and heat and moisture (short-range). During a bite, mosquito saliva is injected into the victim. This liquid contains the substances that cause the classic reaction—a small white or red bump that itches, and then disappears. Those who have been sensitized because of previous bites can have delayed (12 to 48 hours) reactions, which include intense swelling and itching. In addition, mosquitoes transmit diseases such as malaria (see page 146) and various types of encephalitis.

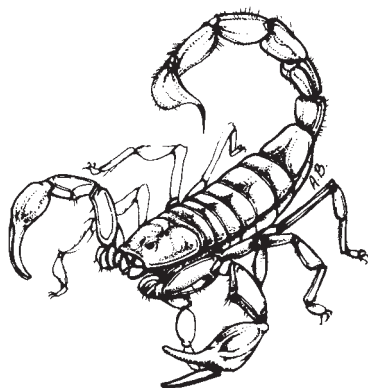


Figure 208. Scorpion.

Therapy for mosquito bites is limited to cool compresses and skin hygiene to prevent infections. If someone is bitten intensely and suffers a severe delayed allergic reaction, he may benefit from a course of prednisone similar to that used to treat poison oak (see page 234). Oral antihistamines, such as cetirizine hydrochloride, given before mosquito exposure, may lessen the reaction to mosquito bites in highly sensitized persons.

Insect repellents are discussed on page 390.

BITING FLIES

A midge (also called a gnat or no-see-um) is a small biting fly that creates a painful red bump that seems out of proportion to the insect's size. After your immune system has become sensitized to these bites, your reactions seem to become worse with repeated assaults, and you may develop blisters or small sores.

Blackflies, buffalo gnats, turkey gnats, and green-headed flies create larger punctures that may bleed. The immediate pain, swelling (welt), and redness are usually intense and persistent. The sores may last for weeks, and be accompanied by weakness and fever when there are multiple bites. Swollen lymph glands may occur, particularly in children. Horsefly, deerfly, mango fly, breeze fly, and sand fly bites are generally less noxious, but may on occasion be severe. In addition, they may transmit diseases, such as with sand flies and leishmaniasis.

Treatment is symptomatic and similar to that applied under step 5 for the local reaction to an insect sting (see page 376).

FLEAS

Fleas are parasitic on mammals and birds. The wingless body enables the critters to run and jump with ease. They live on blood. They are more active in warmer climates, and are commonly associated with domestic animals. A flea bite usually is a small dark red or purplish dot surrounded by a circular area of lighter redness and swelling. Itching is common. Those who have been sensitized may develop blisters or ulcers. Flea bites may appear in unpatterned clusters, most commonly on the legs, ankles, and feet.

Treatment is symptomatic and similar to that applied under step 5 for the local reaction to an insect sting (see page 376).

The female *Tunga penetrans* flea (burrowing flea, chigo, sand flea, jigger) causes tungiasis in Central and South America and in Africa. The impregnated female flea burrows into a human's skin until only the flea's posterior end remains external. The insect sucks blood, becomes larger, and appears as a firm, itchy nodule the size of a small pea, which has a dark spot in the center (the hind end of the flea). The most common sites of infestation are the feet, buttocks, or perineum of humans who don't wear shoes or who squat into dusty soil. The burrowed flea can be killed with topical ether; it must then be surgically removed, or severe infection can develop.

CHIGGERS

Chiggers (red bugs, harvest mites) are an enormous nuisance, particularly in the southeastern United States. The adult mites lay their eggs on vegetation (such as grass). The newly hatched larvae attach themselves to a human and inflict the bites; each is terribly itchy, and marked initially with a small red dot that becomes a red welt over the next 24 hours. Bites may number in the hundreds. Blisters, weeping, and severe swelling may appear. The feet and ankles are most commonly affected. The lesions resolve over 2 weeks, but not without flare-ups of intense itching and discomfort.

Treatment is symptomatic and similar to that applied under step 5 for the local reaction to an insect sting (see page 376). One percent phenol in calamine may be helpful. Home remedies for chigger bites are common, and include application of dabs of clear nail polish or meat tenderizer. None are of proven benefit. If a person is bitten intensely and suffers a severe reaction, he may benefit from a course of prednisone similar to that used to treat poison oak (see page 234), or application of superpotent topical corticosteroid cream or ointment, such as 0.05% clobetasol applied thinly several times daily, but for only a few days' duration. Prevention is key; pretreatment of clothing with permethrin, similar to the approach taken to repel ticks, is beneficial.

CENTIPEDES AND MILLIPEDES

Centipedes bite their victims with their fangs, not with their feet or rear-end appendages. *Scolopendra* species bites have been reported to cause burning pain, swelling, redness, and swollen lymph glands. More severe reactions are rare. Treatment is symptomatic and similar to that applied under step 5 for the local reaction to an insect sting (see page 376), with the exception that the application of meat tenderizer has never been suggested to be of benefit for a centipede bite.

Millipedes do not bite their human victims; instead, they eject secretions that can cause skin irritation. In tropical regions, this has been reported to begin with brown skin staining, followed by a burning sensation with blisters. Millipede secretions that enter the eye may cause severe irritation similar to a corneal abrasion (see page 180). There is no specific treatment, other than to irrigate the affected area (particularly the eyes) promptly and thoroughly with disinfected water or saline solution, and then treat as a burn (see page 108) or, if the eye is injured, as a corneal abrasion (see page 180).

TICKS

Ticks (Figure 209) are ubiquitous in wooded regions and fields, and readily attach to the skin of victims, most commonly on the legs, lower abdomen, genitals, back, and buttocks. They may also attach to the scalp, armpits, groin, and other cozy (for a tick) areas. They like shade and moist skin, and may wander for a while

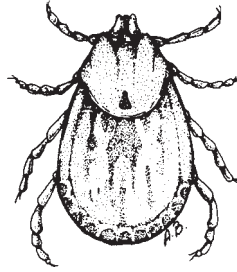


Figure 209. Tick.

in search of a comfortable spot. Up to 20% of tick attachments are in locations that cannot be visualized by the victim. Once in place, ticks hang on with their mouthparts and feed on the victim's blood. The tick is the intermediate host for the vectors of many diseases, such as Rocky Mountain spotted fever (see page 155), Colorado tick fever (see page 156), relapsing fever (see page 153), ehrlichiosis (see page 159), babesiosis (see page 159), and Lyme disease (see page 157). In fact, ticks are the most common insect vectors of disease in the United States.

A tick bite can cause a local reaction that ranges from the common small, itchy nodule to an extensive ulcer. It is common to see redness, swelling, and itching at the site of a tick bite. Some tick mouthparts are barbed, and there may also be a cement secreted by the tick to anchor it into the victim. With large or multiple bites, the victim may suffer fever, chills, and fatigue in the absence of infection. Normally, the bite wounds resolve over a week or two. A persistent lump may be a collection of reactive (to tick saliva) tissue that requires surgical excision.

Tick Paralysis

If a person (particularly a young child with long hair) is traveling in or has just returned from tick country and begins to complain of fatigue and weakness, you may have discovered a case of tick paralysis.

The disorder is most common in spring and summer when ticks are feeding. Certain female ticks (North American wood tick, common dog tick, and Australian marsupial tick) attach to the skin and slowly (over several days) release a neurotoxin that causes profound lethargy and muscle weakness in the victim. The disorder usually begins 5 to 7 days after tick attachment. At first the victim may be irritable and restless, and complain of numbness and tingling in his hands and feet. Over the next day or two (but occasionally as quickly as within a few hours), the victim becomes weak, with an ascending (beginning in the feet and advancing toward the head) paralysis, which can become total. Just a portion of the face can be paralyzed if a tick is lodged behind the ear.

Search the skin (particularly the hair-covered areas) thoroughly for ticks and remove them properly (see below). Improvement is usually noted within hours, and complete recovery occurs in 24 to 48 hours after removal of the tick. However, if the tick isn't removed, the victim can die.

Tick Avoidance

When traveling in forests and fields, it is a good idea to inspect the body thoroughly (particularly the hairline, groin, underarms, navel, scalp, and other hair-covered areas) for ticks each day. Don't forget to brush ticks out of the fur of all dogs and pack animals.

Wear proper clothing to prevent tick attachment. Ticks have a more difficult time attaching to smooth, tightly woven fabrics. Keep shirts tucked into pants and trouser cuffs tucked into socks. Light-colored clothing displays ticks. If clothing is worn loosely fitting, it will not be pulled close to the skin, and it will be more difficult for a tick or insect to bite through and reach the skin. If mesh clothing or a head net is deployed, the mesh size should be less than 0.3 mm. Wear a light-colored, broad-brimmed hat to protect the head and neck. If ticks are seen on clothing, they may be removed by trapping them on a piece of cellophane tape or using a sticky tape lint roller device. Unless a hot cycle in a clothing dryer is employed, washing clothing may not remove tick nymphs. The deer tick, which transmits the infectious agent of Lyme disease, is extremely small, particularly in juvenile stages. The best repellent is permethrin (Permanone) applied to clothing, not to skin (see page 390), but DEET is also effective.

Tick Removal

The proper way to remove a tick is to grasp it close to its mouthparts with tweezers or with the fingernails and pull it straight out with a slow and steady motion (Figure 210). Another excellent way to remove a tick is with a grooved or V-shaped device designed to slide between the tick and the skin to trap the tick and allow it to be pulled from the skin. Do not twist the tick. If you must remove it with your fingers, use tissue paper or cloth to prevent skin contact with infectious tick fluids. Do not touch the tick with a hot object (such as an extinguished match head) or cover it with mineral oil, alcohol, kerosene, camp stove fuel, or Vaseline; these remedies might cause the tick to struggle and regurgitate infectious fluid into the bite site. Viscous lidocaine 2% applied to a tick for 5 minutes will cause it to

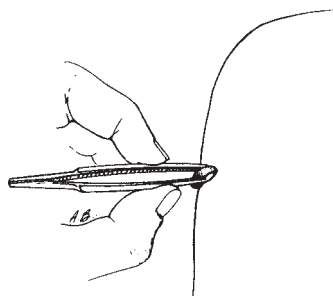


Figure 210. Removing a tick with tweezers.

detach its grip, but it is not known if the tick regurgitates. If a tick head is buried in the skin, you can apply permethrin (Permanone insect repellent), using a cotton swab, to the upper and lower body surfaces of the tick. After 10 to 15 minutes, the tick will relax and you will be able to pull it free. After the tick is removed, carefully inspect the skin for remaining head parts, and gently scrape them away. Wash the bite site with soap and water or with an antiseptic, and also wash your hands.

CATERPILLARS

The puss caterpillar, *Megalopyge opercularis* (Figure 211), is found in the southern United States. The gypsy moth caterpillar, *Lymantria dispar* (Figure 212), and the flannel moth caterpillar, *M. cirpata*, are found in the northeastern United States. The numerous bristles that cover the bodies of these species cause skin irritation when the caterpillar is directly touched, or when there is contact with detached bristles deposited on outdoor bedding or hung clothes. Shortly after exposure, the victim suffers a rash with redness, itching, burning discomfort, and hives. Blisters are rare. If a large area of skin is involved, the victim can become nauseated and weak, and can suffer from high fever. If the small bristle hairs are inhaled, shortness of breath or asthma-like (see page 45) symptoms may follow. If the eyes come into contact with these hairs, symptoms include redness, itch-



Figure 211. Puss caterpillar.



Figure 212. Gypsy moth caterpillar.

ing, tearing, and swollen eyelids. Handling particularly venomous species can cause intense pain, headache, fever, vomiting, and swollen lymph glands.

Treatment of the skin consists of applying adhesive tape (duct tape is best) to attempt removal of the bristles, followed by an application of calamine lotion. A good alternative is to apply a commercial facial peel or thin layer of rubber cement, allow it to dry, and then peel it off; the bristles will be carried with it. Management of an allergic reaction similar to that from poison oak is described on page 234. If the redness and swelling are prominent, the victim may be treated with an oral antihistamine, such as fexofenadine (60 mg twice a day) and a nonsteroidal antiinflammatory drug for 5 days. If the pain is severe, administer a potent pain medicine.

BEETLES

Beetles are the largest group of insects. Fortunately, no beetle has a bite or sting that can envenom a human, although some types produce toxic secretions that can be deposited on the skin.

Blister beetles of the *Epicauta* species (Figure 213) are found throughout the eastern and southern United States. These insects are usually about $\frac{1}{2}$ in (1.3 cm) long and extremely agile. When they make contact with the skin, they release a chemical substance (cantharidin) that is very irritating. Initial contact is painless. Within a few hours, blisters appear, which are not particularly painful unless they are large and broken. If a blister beetle is squashed on the skin, an enormous blister follows.

The treatment is the same as for a second-degree burn (see page 108). If “beetle juice” enters the eye, the eye should be irrigated copiously and the injury managed as you would snowblindness (see page 187). In general, it is a good idea to wash the skin with soap and water after any insect contact.

SUCKING BUGS

These insects have sucking mouthparts, and are typified by the assassin bugs and their subset of triatomids (“kissing bugs,” “wheel bugs,” and Mexican bedbugs). Aquatic sucking bugs include the giant water bugs and “water scorpions.”

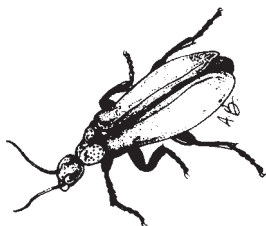


Figure 213. Blister beetle.

Triatomids (Figure 214) usually bite humans during the night on exposed body parts, and feed for up to 30 minutes. The initial bite is painless, without any immediate reaction. However, the wheel bug, black corsair, or masked bedbug hunter bite may cause pain similar to a hornet sting.

A triatomid may continue to bite until there is a cluster or line of red, itchy bumps that may last for up to a week. If the reaction is more severe, there are large hives, swollen lymph glands, fever, and blisters. Bedbug bites often create an itchy bump with a central red spot.

Treatment is symptomatic and similar to that applied under step 5 for the local reaction to an insect sting (see page 376).

SKIN INFESTATION BY FLY LARVAE

Skin infestation by fly larvae is called myiasis, and is most commonly noted in Mexico and Central and South America, the latter two with the botfly *Dermatobia hominis*. The fly egg, which may actually be carried by another species of insect (such as the mosquito), is deposited onto human skin, where it hatches, allowing the emerging larva to burrow into the skin through the insect bite or another opening (such as a hair follicle or small scratch or nick).

The larva then develops within a dome-shaped cavity (swelling) that enlarges over 4 to 7 weeks. A central breathing pore drains clear or slightly bloody fluid. Drainage may begin within the first 2 weeks after penetration. There is often redness and itching. Movement may be felt under the skin as the larva wiggles. This may also feel like a crawling sensation or brief flash of sharp pain, because the larva has many parallel rows of bristly spines.

The mature larva will attempt to exit the skin through the breathing pore, and is noticed as a small white object “peeking” through the hole. To test to see if a larva is present, place a small amount of the victim’s saliva over the hole—if it bubbles, the larva is likely there and breathing. You can force it to exit through the hole by suffocating it: Cover the breathing pore with bacon or pork fat, a strip of meat, chewing gum, wax, fingernail polish, paraffin, or a plug of grease. Usually, 12 hours of occlusion will cause the larva to exit the hole or die from asphyxiation. Moistened tobacco leaves or nicotine drops will paralyze the larva. It is unwise to make a rough incision to remove the larva, because if the creature is ruptured,

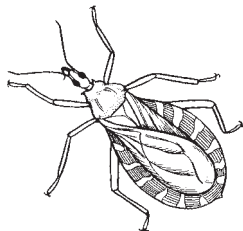


Figure 214. Triatomid “kissing bug.”

it will leak substances into the wound that cause inflammation and promote infection. It is sometimes possible to simply squeeze the lesion and force extrusion of the larva, but care must be taken not to rupture the larva. If nothing is done to force the larva to leave the skin, it will do so on its own in a few weeks, but this is generally not recommended because of the pain and potential for abscess (see page 241) formation.

Other fly larvae that can invade humans and cause myiasis may “migrate,” or travel under the skin, usually settling over the head or shoulders. They may emerge from the lesions or die where they are, in which case they don’t need to be removed.

Wound myiasis describes the situation in which flies (including the green- or bluebottle fly, housefly, black blowfly, and flesh fly) have deposited eggs into a wound, where the larvae feed on the decaying tissue. This is seen most commonly in elderly victims with underlying chronic diseases. The “maggots” are unsightly, but do not harm the victim. Screwworms, on the other hand, which originate from outbreaks among livestock, may invade humans and cause destructive ulcers, particularly if they enter through the nose.

For wound myiasis confined to the skin, a mixture of 5% chloroform in olive oil kills the larvae, so that they can be removed manually. In the absence of this mixture, simple irrigation and mechanical removal of the larvae will suffice.

INSECT REPELLENTS

In insect-laden areas, where contact is inevitable, the traveler must wear proper clothing. Cover the head and neck with a full-brimmed hat (with or without netting) and scarf (temperature permitting). Shield the ankles and wrists. Tuck pant cuffs into socks. Light-colored clothing is less attractive than dark clothing to biting insects, and also makes it easier to spot any mosquitoes, ticks, and flies that have landed.

Nylon (particularly double layered) and sailcloth are more difficult for insects to hang on to or penetrate and are generally preferred over cotton or cloth with a loose weave. Loose-fitting clothing made with tightly woven fabric, along with a T-shirt underlayer, makes for reasonable upper-body protection. Where clothing can be pulled tight against the skin, a mosquito can bite through.

Clothing needs to be checked regularly and brushed free of insects; this is best done with the sticky side of adhesive tape.

Portable insect screens and bed nets should be deployed when necessary. The use of artificial lights, which draw insects, should be avoided.

Insect repellents applied to clothing are extremely effective and avoid skin irritation. It is a good idea to test the repellent on a small area of clothing before general application, to be certain that it will not blemish the fabric.

Chemical insect repellents are mandatory whenever you travel through mosquito, sand fly, or tick territory. Different repellents work by different mechanisms and therefore their effectiveness varies for different types of insects, but

I can make some general recommendations that will be applicable in most situations.

Effective repellents contain the chemicals DEET (N,N-diethyl-3-methylbenzamide), Indalone (butyl 3,4-dihydro-2,2-dimethyl-4-oxo-2H-pyran-6-carboxylate), Rutgers 612 (2-ethyl-1,3-hexanediol), and DMP (dimethyl phthalate). Picaridin (also known as KBR 3023; brand name Bayrepel) is a newer repellent that is odorless and non-greasy, and should be present in a concentration of 15%. Early anecdotal reports from users suggests that it is not as effective as DEET. Oil of lemon eucalyptus (p-menthane-3,8-diol; Repel Lemon Eucalyptus Repellent) is another increasingly popular repellent that is thought to be as effective as 7.5% DEET. It is actually not from eucalyptus, but is a product from the lemon-scented gum tree *Corymbia citriodora*. The product is water-distilled from the leaves, and the repellent is found in the spent fraction as para-menthane-3,8-diol (PMD). Of particular note, true eucalyptus oil does not work as an insect repellent. It may be used on children ages 3 years and older. Along with isopulegol and citronellal, eucalyptus is contained in the product Mosiguard Natural.

Di-n-propyl isocinchomeronate (R-326) has been promoted as useful against biting flies. IR3535 (ethyl butylacetylaminopropionate)—containing repellent is far less useful (1 hour maximum protection) than DEET. Mosbar soap is a product sold abroad that contains 20% DEET and 0.5% permethrin. N-octyl bicycloheptene dicarboximide synergist combined with DEET (Sawyer Products' Gold; S. C. Johnson's Ticks OFF or Deep Woods OFF) is a tick repellent, also effective against biting flies and gnats, that can be applied directly to the skin. Neem (*Azadirachta indica*), used in India for millennia, reputedly has both insecticide and repellent properties. Soybean oil, sometimes used in combination with other repellent substances, may in and of itself have repellent properties.

Citronella and Avon Skin-So-Soft bath oil or skin stick are far less effective (15 minutes of protection versus 6 hours with 25% DEET). Other relatively ineffective (protection from a few minutes to [rarely] 2 hours) repellents include essential oils of cedar, peppermint, lemongrass, and geranium. Bite Blocker contains soybean, geranium, and coconut oils and has been claimed effective for up to 3.5 hours against mosquitoes. Bite Blocker for Kids (soybean oil, 2%) provides approximately 90 minutes of protection. Ingesting vitamin B₁ has not been proven to deter biting insects. It may decrease the skin irritation that follows an insect bite, but this would not diminish the transmission of infectious disease(s) via the bite. Ingesting garlic is not effective.

To be effective, a repellent should be applied to the skin (liquid) and clothing (spray). After you swim, bathe, or perspire excessively, reapply it. If you are being bitten by insects, reapply the repellent. In windy conditions, repellents evaporate quickly and may need to be reapplied. Children under 2 years of age should not have insect repellent applied to the skin more than once in 24 hours (it is more effective to apply it to the clothing, anyhow). If you're applying both a sunscreen and an insect repellent, apply the sunscreen first, so that it can be absorbed; wait 30 minutes, and then apply the insect repellent. There are also sunscreen–insect

repellent combinations, such as Coppertone Bug & Sun. Bug Guard contains Skin-So-Soft (mostly mineral oil) in combination with citronella, enhanced by a sunscreen.

With regard to DEET-containing products, do not use repeated applications or concentrations greater than 15% in children under age 6 (Skedaddle, Skintastic, and other preparations intended for use on children contain approximately 6.5% to 10% DEET). In adults, skin irritation and/or rare severe side effects may be seen following the use of concentrated (75% to 100%) products. Most authorities recommend avoidance of concentrated products, noting the effectiveness of a 50% concentration in jungle settings. A concentration not to exceed 30% to 50% for routine adult use seems reasonable. One recommended product is Ultrathon Insect Repellent (35% DEET). A product that may significantly decrease absorption of DEET is Sawyer Controlled Release Deet Formula, which uses a protein that encapsulates the DEET and allows slow (sustained) release of its 20% concentration. It should be applied to skin, not clothing. Care should be taken to avoid contact of DEET with plastics, rayon, spandex, leather, or painted and varnished surfaces, because the DEET may cause damage to these.

The following recommendations are offered to avoid toxicity:

1. Apply repellent sparingly, and only to exposed skin or clothing. Keep it out of the eyes. Do not apply repellent underneath clothing.
2. Avoid high-concentration products on the skin, particularly with children.
3. Do not apply repellent to cuts, wounds, or irritated skin. Apply to face by dispensing into the palms of your hands, and then using these to apply a thin layer to the face. Afterward, wash your hands.
4. Do not inhale or ingest repellents. Do not spray aerosol or pump products directly on your face. Spray your hands and then use them to rub the repellent on the face, avoiding the eyes and mouth. Do not spray around food.
5. Use long-sleeved clothing and apply repellent to fabric rather than to skin.
6. Don't use repellent on children's hands, which may be rubbed in the eyes or placed in the mouth.
7. Repellent applied to a wristband is not sufficient protection—you must apply the repellent directly to all the skin areas to be protected.
8. Do not reapply repellent in normal weather conditions (unless it is a non-DEET repellent).
9. Wash repellent off the skin after the insect bite risk has ended.

Permethrin, a synthetic pyrethroid based on the naturally occurring pyrethroids that are extracted from the East African pyrethrum flower (a chrysanthemum), is actually an insecticide; that is, permethrin-containing products kill insects and ticks. Because permethrin carries some potential toxicity to humans it should be used only on clothing (or on shoes, certain camping gear, bed nets, etc.), not on skin. For instance, permethrin is known to cause eye irritation if the chemical comes in contact with a person's eyes. Although permethrin in a 5% lotion or cream is sometimes prescribed by physicians for application to skin for treatment of mite (e.g., scabies) infestation, these medical dermatologic preparations are not recommended for use

as insect repellents. In the past, combination DEET-permethrin (the latter in very low concentration) soaps have been field tested for use as an insect repellent. While they have been acceptable to the persons who used them, a commercial product based on this concept has not yet come to market.

There is ongoing discussion about the toxicities possibly associated with permethrin. These include potential cancer-causing potential, and perhaps abnormalities of the immune system. Properly used (e.g., applied to clothing and not directly to skin), permethrin has not yet been directly linked with serious adverse effects on humans, so it remains an effective barrier against insect-borne infections, such as Lyme disease and West Nile virus. It is best used in combination in its application to clothing with an approved insect repellent (such as picaridin or DEET), when the latter is applied to skin.

There are many permethrin wash-in products for clothing on the market. An example is Sawyer Permethrin Wash-In Clothing Treatment. Another is BUZZ OFF Insect Shield apparel, which is claimed to provide effective and convenient protection against mosquitoes, ticks, ants, flies, chiggers, and midges. It is important to closely follow the label instructions. Clothing that is sold pretreated with permethrin is often advertised to be effective (as a repellent) for up to 25 washings. If you are going to be in a high-risk (for an insect or arthropod bite capable of transmitting a disease) situation, to play it safe, the effectiveness should be assumed to begin to decrease after half the advertised allowable number of washings. Also, it should not be assumed to protect skin adjacent to the clothing, only to keep insects from biting through the clothing.

If you decide to apply permethrin spray to clothing, be certain to do the following:

1. Follow the manufacturer's instructions closely. Do not exceed recommended spraying times.
2. Treat clothing only. Do not apply to skin.
3. Apply the permethrin in a well-ventilated outdoor area, protected from the wind.
4. Only spray the permethrin on the outer surface of clothing and shoes.
5. In a concentration of 0.5%, it can be sprayed on both sides of clothing to lightly moisten the outer surface of the clothing item; it is not necessary to have the clothing soaked through (saturated).
6. Be certain to apply completely over socks, trouser cuffs, and shirt cuffs, where insects may attempt to crawl or fly through openings to your skin.
7. Hang treated clothing outdoors and allow to dry for at least 2 to 4 hours in nonhumid conditions and for at least 4 hours in humid conditions.
8. Treat clothing no more often than every 2 weeks.
9. Launder treated clothing separately from other clothing at least once before retreating.
10. Assume that your treated clothing is effective for repellency for 2 weeks or more. Wear it only when you need to repel insects and arthropods. Store it in a separate impermeable (to permethrin) bag when not in use.

Permethrin (Permanone tick repellent; Duranon tick repellent) may be applied to clothing, netting, and footwear. A single application is usually good for 1 to 2 weeks, or 20 washings. To apply permethrin to clothing or netting, add 2 ounces of permethrin to a quart of water in a plastic bag. The solution will turn milky white. Put the garment or netting in the bag, seal the bag, and let the item soak for 10 minutes. After the soak, allow the clothing or netting to effectively dry (in the sun or hung) for a few hours. Permethrin is effective against ticks and mosquitoes.

PermaKill 4 Week Tick Killer is a 13.3% permethrin liquid concentrate that is diluted ($\frac{1}{3}$ oz, or 10 mL, in 16 oz, or 473 mL, of water) to be sprayed from a pump bottle. It can also be diluted 2 oz (59 mL) in $1\frac{1}{2}$ (355 mL) cups of water to soak a bed net, shirt, and pants, which are then air-dried.

Fleas, horseflies, blackflies, sand flies, deerflies, chiggers, gnats, and other assorted nuisances may not be driven away by insect repellents. Protective netting and a lot of swatting may be your only defenses. A head net may be invaluable during times of high mosquito infestation. If you use a bed net, be certain that it is free of holes and has its edges tucked in. The net needs to be woven to a tightness of 18 threads per inch (6 to 7 per cm). Tighter mesh may hinder ventilation and create an uncomfortable environment. A net that has been dipped in an insecticide, usually permethrin, is more effective.

Electric-light traps with electrocution grids, ultrasound devices, and audible sound devices have not been shown scientifically to repel insects or to decrease the concentration of biting insects in their vicinity. Mosquito traps, such as The MegaCatch Premier Mosquito Trap or the Mosquito Magnet are advertised to be effective. They emit combinations of chemical attractants, carbon dioxide, heat, and moisture to draw mosquitoes and certain other biting insects close enough to a suction intake to be captured.

To date, plant products, with the potential future exception of an extract of eucalyptus oil, do not appear to repel insects as well as DEET. Although allspice, bay, camphor, cedar, cinnamon, citronella, geranium, lavender, nutmeg, pennyroyal, peppermint, pine, thyme, and verbenas may have repellent properties, they are limited in effectiveness in comparison to DEET.

LEECHES

Leeches are parasitic annelid worms that live on land or in water. They attach to human skin with a painless bite to extract blood through the skin. Some of them release a substance called hirudin, which is an anticoagulant (causes increased tendency to bleed). Aquatic leeches are found in fresh water, and are considered more dangerous than those on land, because they can attach inside the mouth, throat, lungs, vagina, urethra, and other internal sites.

To remove a leech, don't pull it off—the residual sore may be larger. Instead, apply lemon juice, salt, vinegar, tobacco juice, or insect repellent. Using a lighted

or recently extinguished match or glowing ember may cause a skin burn. If the detached leech sticks to your fingers, roll it between them. If a leech is attached to someone's eye, shine a flashlight close to it; it may move toward the light and away from the eye. The medical considerations for a leech bite are itching and secondary infection. Insect repellents (see page 390), particularly DEET applied to clothing and skin, will discourage leech attachment. Slippery grease (such as petroleum jelly) applied to exposed skin may also help. Wear waterproof boots when wading in leech-infested water, and tuck in pant legs.



LIGHTNING STRIKE

Lightning strikes the earth at least 100 times per second during an estimated 3,000 thunderstorms per day. Fortunately, the odds of being struck by lightning are not very great. Still, approximately 60 persons per year are victims of fatal strikes in the United States. The wise traveler respects thunderstorms and seeks shelter at all times during a lightning storm.

Lightning is the direct-current electrical discharge associated with a thunderstorm; it releases an initial charge (the vast majority of which travels from ground [positive] to cloud [negative]) of approximately 30 million volts to neutralize a potential difference (within a hundredth to a ten-thousandth of a second) of 200 million to a billion volts. A lightning flash may be made up of multiple (up to 30) strokes, which causes lightning to seem to flicker. Each stroke lasts less than 500 milliseconds. The diameter of the main stroke is 2½ to 3 in (6 to 8 cm); the temperature has been estimated to be anywhere from 14,432°F to 90,032°F (8,000°C to 50,000°C—four times as hot as the surface of the sun). Within milliseconds, the temperature falls to 3,632°F to 5,432°F (2,000°C to 3,000°C).

Thunder, which is always present with lightning, is attributed to the nearly explosive expansion of air heated and ionized by the stroke of lightning. To estimate the approximate distance in miles from your location to the lightning strike, time the difference in seconds between the flash of light and the onset of the thunder, and divide by five.

Lightning can injure a person in five ways:

1. Direct hit, which most often occurs in the open.
2. Splash, which occurs when lightning hits another object (tree, building). The current seeks the path of least resistance, and may jump to a human. Splashes may occur from person to person, or from a metal fence.
3. Contact, when a person is holding on to a conductive material that is hit or splashed by lightning.
4. Step (stride) voltage (or ground current), when lightning hits the ground or an object nearby. The current spreads like waves in a pond.
5. Blunt injury, which occurs from the victim's own muscle contractions and/or from the explosive force of the shock wave produced by the lightning strike. These can combine to cause the victim to be thrown, sometimes a considerable distance.

When lightning strikes a person directly, splashes at him from a tree or building, or is conducted along the ground, it usually largely flows around the outside of the body (flashover phenomenon), which causes a unique constellation of signs and symptoms. The victim is frequently thrown, clothes may be burned or torn ("exploded" off by the instantaneous conversion of sweat to steam), metallic objects (such as belt buckles) may be heated, and shoes removed. The victim often undergoes severe muscle contractions—sufficient to dislocate limbs. In most cases, the person struck is confused and rendered temporarily blind and/or deaf. In some cases, there are linear ($1\frac{1}{2}$ to 2 in, or 1.3 to 5 cm, wide, following areas of heavy sweat concentration), "feathered" (fernlike; keraunographism; Lichtenberg's flowers—cutaneous imprints from electron showers that track over the skin) (Figure 215, A), or "sunburst" patterns of punctate burns over the skin (Figure 215, B), loss of consciousness, ruptured eardrums, and inability to breathe. Occasionally, the victim ceases breathing and suffers a cardiac arrest. Seizures or direct brain damage may occur. Eye injuries occur in half of victims.

A victim struck by lightning may not remember the flash or thunder, or even recognize that he has been hit. The confusion, muscle aches, body tingling, and

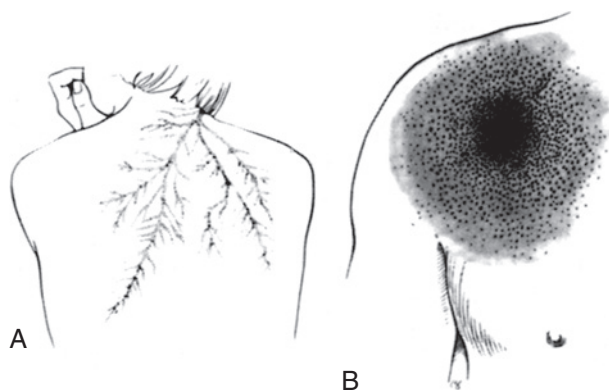


Figure 215. A, Ferning lightning burn. B, Punctate (starburst) lightning burn.

amnesia can last for days. With a more severe case, the skin may be mottled, the legs and/or arms may be paralyzed, and it may be difficult to locate a pulse in the radial (wrist) artery (see page 33), because the muscles in the wall of the artery are in spasm. First-, second-, or third-degree skin burns may be present. Broken bones are not uncommon.

If a person is found confused, burned, or collapsed in the vicinity of a thunderstorm, consider the possibility that he was struck by lightning. The victim is not “electrified” or “charged”—you will not be jolted or stunned if you touch him.

1. Maintain the airway and assist breathing (see page 29). Continue to perform artificial respiration and cardiopulmonary resuscitation (CPR) (see page 32) until sophisticated help can be obtained. Victims of lightning strike may have paralysis of the breathing mechanism for a period of 15 to 30 minutes, and then make a remarkable recovery. A seemingly lifeless individual may be saved if you breathe for him promptly after the injury. Do not assume that dilated or nonreactive (to light—see page 36) pupils are a sign of death, because they may represent direct injury to the eye(s).
2. Assume that the victim has been thrown a considerable distance. Protect the cervical spine (see page 37).
3. Examine the victim for any other injuries and treat accordingly.
4. Transport the victim to a hospital.
5. If you are in the vicinity of a thunderstorm, seek shelter for the victim and yourself. Lightning *can* strike twice in the same place!

LIGHTNING AVOIDANCE

1. Know the weather patterns for your area. Don't travel in times of high thunderstorm risk. Avoid being outdoors during a thunderstorm. Carry a radio to monitor weather reports. Lightning can lash out from many miles in front of a storm cloud, in seemingly clear weather. If you calculate (see above) that a nearby lightning strike is within 3 miles (5 km) of your location, anticipate that the next strike will be in your immediate area. The “30-30 rule” specifies that if you see lightning and count less than 30 seconds before hearing thunder, seek shelter immediately. Since thunder is rarely heard from more than 10 miles away, if you hear thunder, it is best to curtail activities and seek shelter from lightning. Do not resume activities outdoors for at least 30 minutes after the lightning is seen and the last thunder heard.
2. If a storm enters your area, immediately seek shelter. Enter a hard-roofed auto or large building, if possible. Tents and convertible autos offer essentially no protection from lightning. Tent poles are lightning rods. Metal sheds are dangerous because of the risk of side splashes. Indoors, stay away from windows, open doors, fireplaces, and large metal fixtures. Inside a building, avoid plumbing fixtures, telephones, and other appliances attached by metal to the outside of the building.

3. Do not carry a lightning rod, such as a fishing pole or golf club. Avoid tall objects, such as ski lifts and power lines. Avoid being near boat masts or flagpoles. Do not seek refuge near power lines or tall metal structures. If you are in a boat, try to get out of the water. If you are swimming in the water, get out. Do not stand near a metal boat. Insulate yourself from ground current by crouching on a sleeping pad, backpack, or coiled rope.
4. Move off ridges and summits. Thunderstorms tend to occur in the afternoon, so attempt to summit early and be heading back down by noon. In the woods, avoid the tallest trees (stay at a distance from the tree that's at least equal to the tree's height) or hilltops. Shelter yourself in a stand of smaller trees. Avoid clearings—you become the tallest tree. Don't stay at or near the top of a peak or ridge. Avoid cave entrances. In the open, crouch down or roll into a ball.
5. Stay in your car. If it is a convertible, huddle on the ground at least 50 yards (46 m) from the vehicle.
6. If you are part of a group of people, spread the group out so that everyone isn't struck by a single discharge.
7. If your hair stands on end, you hear high-pitched or crackling noises, or see a blue halo (St. Elmo's fire) around objects, there is electrical activity near you that precedes a lightning strike. If you can't get away from the area immediately, crouch down on the balls of your feet and keep your head down. Don't touch the ground with your hands.
8. The StrikeAlert Personal Lightning Detector (Outdoor Technologies, Inc.) is the size and configuration of a pager and uses an audible warning and LED display to show the wearer how far away lightning is striking and if a storm is approaching or leaving.

TORNADO AVOIDANCE

1. Watch the cloud formations in a stormy sky. If you see revolving, funnel-shaped clouds, you are in danger.
2. Take shelter immediately. The best location is an underground cave or concrete structure. Do not remain in a tent or camper.
3. If you are caught outside in open country, hunker down or lie flat in a depression, ditch, culvert, or ravine. Cover your head with your arms.
4. Do not try to outrun a tornado. There is no way to predict when it will change direction.

WHAT TO DO IN AN EARTHQUAKE

If you are caught in an earthquake in a wilderness setting, do the following:

1. Seek a safe location, out of the path of a rockfall, mudslide, or snow avalanche. If you can, move into a clearing away from buildings, trees,

and power lines. If the ground shaking is extreme, position yourself on your hands and knees.

If you are in a moving vehicle, drive to a clearing, exit the vehicle, and stay next to it until the shaking stops. If something collapses on it while you are inside, you may be crushed. If you are outside the vehicle, it may compress and create a safe space adjacent to it.

If you are indoors, stay put until you are certain that it's safe to go outside. Move away from glass windows. Curl into a fetal position, and position yourself next to something that can compress, but not crush, and thereby protect you by leaving an adjacent void. If you are in a bed during an earthquake, roll off the bed and remain next to it. Do not remain in a doorway, and try to stay off stairs.

2. Eliminate any obvious fire hazards. If you are in a cabin supplied with natural gas, turn it off at the source if there is any odor or you believe there might be a leak.
3. Be prepared for aftershocks.
4. Secure a supply of drinking water. Be certain that you are prepared for a period of time without electrical power.
5. Prepare a shelter, store sufficient food, and locate equipment necessary for survival. Keep first-aid supplies and a flashlight within easy reach.

VOLCANOES

The eruption of a volcano can be a cataclysmic event. Since recorded time, pyroclastic flows (described below) have killed the greatest number of people, while flying solid objects (called "tephra" by volcanologists) thrown out by the volcano are the most frequent killers. Usually, when an explosive volcano erupts, a cloud of gas, ash, and lava fragments rises up into the atmosphere. If the eruption cloud becomes more dense than the surrounding air, it may fall back toward the ground, propelled by the forces of gravity. This can lead to formation of an incredibly hot (more than 1,500°F), high-speed (faster than 180 miles per hour) avalanche of ash, volcanic gases, lava fragments, and heated air, which is called a pyroclastic flow. The extreme temperatures may also generate gale-force winds. Because of the forces and temperatures involved, no living being caught in this infernal river can survive. Most human victims die from suffocation, exposure to the heat, or burial under the volcanic debris. Anyone who travels in the vicinity of an active volcano should be aware of the risks and have a well thought out, realistic evacuation plan.

What to Do if Working or Traveling Near an Active Volcano

1. To learn the volcano's pattern of eruption, read about past eruptions and accidents.
2. Know the current volcano warning level. Obey local authorities.

3. Travel with an experienced guide.
4. Leave details about your itinerary with someone who can report you as delayed or missing.
5. Wear a hardhat and carry a gas mask.
6. Beware of rockfall, avalanche, and hazardous gases.
7. Observe for warning signs of an eruption. Leave immediately if the area becomes dangerous.
8. Do not approach lava that is flowing through vegetation.

SNOW AVALANCHES

Some of the factors that influence a buried victim's chances for survival are time buried, depth buried, clues on the surface (to facilitate location of the victim and rescue), rescue equipment, injury, ability to fight the avalanche, body position, snow density, presence of air (breathing) pocket and size of air pocket, and luck. A victim who is uninjured and able to fight on the downhill ride usually has a better chance of ending up only partly buried, or if completely buried, a better chance of creating an air pocket for breathing. A victim who is severely injured or knocked unconscious is like a rag doll being rolled, flipped, and twisted. Being trapped in an avalanche is a life-and-death struggle, with the upper hand going to those who fight the hardest.

Avalanches kill in two ways. First, serious injury is always possible in a tumble down an avalanche path. Trees, rocks, cliffs, and the wrenching action of snow in motion can do horrible things to the human body. Second, snow burial causes asphyxiation (either obstructed airway or exhausted oxygen supply). A very small percentage of avalanche victims succumb to hypothermia, probably because they succumb to injuries or asphyxia before they have a chance to become sufficiently hypothermic to expire.

The problem of breathing in an avalanche does not start with being buried. A victim swept down in the churning snow has an extraordinarily hard time breathing. Inhaled snow clogs the mouth and nose; asphyxiation occurs quickly if the victim is buried with the airway already blocked. Snow that was light and airy when a skier carved turns in it becomes viselike in its new form.

Snow sets up hard and solid after an avalanche. It is almost impossible for victims to dig themselves out, even if buried less than a foot deep. Hard debris makes recovery very difficult in the absence of a sturdy shovel. The pressure of the snow in a burial of several feet sometimes is so great that the victim is unable to expand his or her chest to draw a breath. Warm exhaled breath freezes on the snow around the face, eventually forming an ice lens that cuts off all airflow.

Another factor that affects survival is the position of the victim's head; that is, whether the victim is buried face up or face down. The most favorable position is face up. Data from a limited number of burials show that the victim is twice as likely to survive if buried face up rather than face down. If buried face up, an air pocket forms around the face as the back of the head melts into the snow; if buried face down, an air pocket cannot form as the face melts into the snow.

A completely buried victim has a poor chance of survival. Survival is interrelated with both time and depth of burial. Survival probabilities diminish with increasing burial depth. To date, no one in the United States who has been buried deeper than 7 ft (2.1 m) has been recovered alive.

Time is the true enemy of the buried victim. In the first 15 minutes, more persons are found alive than dead. At 30 minutes, an equal number are found dead and alive. After 30 minutes, more are found dead than alive, and the survival rate continues to diminish. In favorable circumstances, buried victims can live for several hours beneath the snow; therefore rescuers should never abandon a search prematurely. In 2003, two snowshoers caught near Washington's Mt. Baker survived burials of 22 and 24 hours. Such long survival times are a reminder that no rescue should be abandoned prematurely on the thought that the victim is dead.



UNDERWATER DIVING ACCIDENTS AND DROWNING

On land at sea level, the human body is constantly exposed to 14.7 lb (6.7 kg, or 1 atmosphere) of pressure from the weight of the atmosphere (an air column 165 miles, or 266 km, high). As a human descends under water in the ocean, with every 33 ft (13 m) of depth an additional atmosphere of pressure is exerted. With increasing pressure (P) that occurs on descent, the volume (V) of gas in an enclosed space is diminished, as determined by Boyle's law: $P_1V_1 = P_2V_2$. Conversely, during ascent from the depths, the gas in an enclosed space expands. Under water, the greatest relative volume changes with increasing and decreasing pressure occur near the surface (Figure 216).

AIR EMBOLISM

An air embolism occurs when there is a rupture in the barrier between the microscopic air space of a lung and its corresponding blood vessel, which carries oxygenated blood back to the heart (where it can be distributed to the body). In effect, bubbles of air are released into the arterial bloodstream, where they act as physical barriers to circulation, and can cause a stroke (see page 144), heart

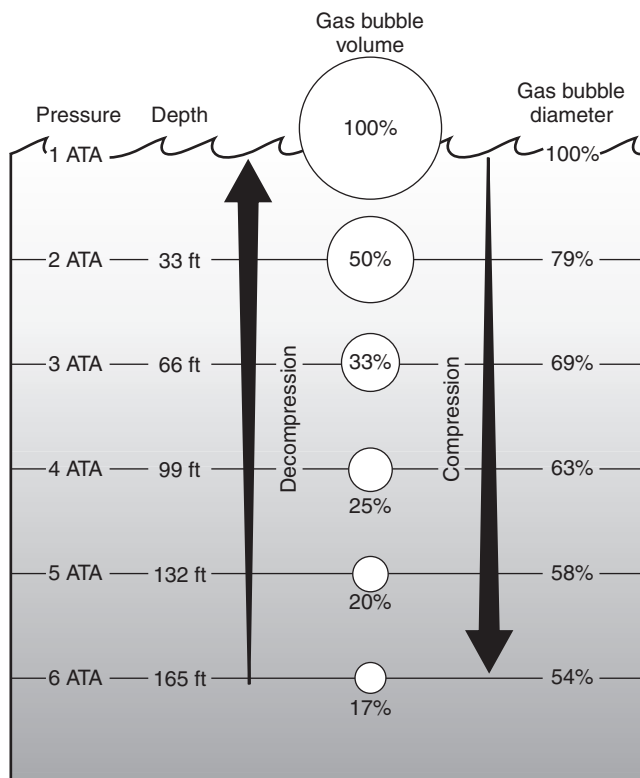


Figure 216. Volume changes with depth and pressure.

attack (see page 50), headache, and/or confusion. Typically, the victim is a scuba (self-contained underwater breathing apparatus) diver who ascends too rapidly without exhaling, thus allowing overexpansion of the lungs—and rupture of the tissue—as the external water pressure decreases with ascent. In other words, as a diver ascends from the depths, the air in his lungs (which was delivered from the scuba tank through a regulator at a pressure equal to the surrounding water pressure on the lungs, thereby allowing lung expansion) expands. If the rate of exhalation does not keep pace with the lung expansion, the increased pressure within the lungs causes air to be forced through the lung tissue, where it appears in the bloodstream in bubble form and travels directly to the heart. From the heart, the air circulates to and may occlude critical small blood vessels that supply the heart, brain, and spinal cord.

The most common symptoms are unconsciousness, confusion or disorientation, seizures, and/or chest pain immediately on surfacing. Others include dizziness, visual blurring, loss of vision, headache, abnormal personality, confusion, total or partial paralysis, and weakness. Any disorder that appears in a previously normal diver more than 10 minutes after surfacing is probably not due to air embolism.

Anyone suspected of having suffered an air embolism should be placed in a head-down position (with the body at a 15- to 30-degree tilt), turned onto his left side, assisted with breathing if necessary (see page 29), and *immediately transported to an emergency facility*. If oxygen (see page 431) is available, it should be administered by facemask at a flow rate of 10 liters per minute. The treatment for arterial gas embolism is recompression in a hyperbaric oxygen chamber, which pressurizes the victim's environment and shrinks the bubbles. This must be accomplished as rapidly as possible to save the victim's life and to minimize disability. A portable recompression chamber manned by trained personnel may be used to initiate field treatment. If the victim is capable of purposeful swallowing, administer one adult aspirin by mouth.

If the air that expands on ascent does not rupture into a blood vessel and become an air embolism, it can rupture into the actual lung tissues or into the pleural space between the lung and the inside of the chest wall, and cause a collapsed lung (pneumothorax) (see page 41). Other symptoms include air that escapes into the soft tissues, so that there is swelling of the chest and neck, and sometimes a "Rice Krispies" feel to the skin. If the air dissects into the neck, it can cause hoarseness, difficulty swallowing, and sore throat. In this case, oxygen administration is advised. Recompression in a hyperbaric chamber is not advised for a pneumothorax unless there are also severe symptoms associated with an air embolism.

When transporting a victim of air embolism, it is recommended that you use an aircraft that can be pressurized to 1 atmosphere (such as a Lear jet, Hercules C-130, or Cessna Citation), or keep the flight altitude (in an unpressurized aircraft) below 1,000 ft (305 m).

The Divers Alert Network at Duke University Medical Center (919-684-4326 collect or 919-684-8111 toll) provides a 24-hour hotline to assist in the management of all significant diving accidents, as well as evacuation to a facility with a hyperbaric chamber.

DECOMPRESSION SICKNESS (THE "BENDS")

When a scuba diver descends in the water, nitrogen present in the compressed air he breathes is absorbed into the tissues of his body. This process is analogous to the introduction of carbon dioxide into a beverage for the purpose of carbonation. In the human case, there is a limit to the time and depth that a diver can tolerate before exceeding the amount of nitrogen he can absorb safely without a staged decompression (ascent). If this limit is exceeded, and/or if the diver ascends too rapidly, this nitrogen leaves his tissues and enters his bloodstream in the form of microscopic bubbles (like opening a bottle of soda pop).

The signs and symptoms caused by these bubbles in the body represent decompression sickness, also known as the "bends." Symptoms may begin immediately after ascent from a dive or may be delayed by a number of hours. These include deep boring joint pain without swelling-warmth-redness, numbness and tingling

of the arms and legs, difficulty walking, back pain, fatigue, weakness, inability to control the bladder or bowels (spinal cord “hit”), paralysis, double vision, diminished vision, headache, confusion, dizziness, nausea, vomiting, difficulty in speaking, itching, skin mottling (“marbling”), shortness of breath, cough, and collapse. A rapid, simplified neurologic exam (see page 145), such as administered to a suspected stroke victim, may identify a subtle abnormality.

If you suspect someone of suffering the bends, immediately have him begin to breathe oxygen (at a flow rate of 10 liters per minute by facemask) (see page 431) and begin rapid transport to an emergency facility. Oxygen breathing should occur for at least 30 minutes. The definitive treatment is recompression in a hyperbaric chamber. *Do not put the diver back into the water to attempt in-water recompression*; this can be very hazardous. If possible, have the victim lie down in a comfortable position, preferably on his side, but do not let him obstruct blood flow to a limb by resting his head on an arm or crossing his legs. A portable recompression chamber manned by trained personnel may be used to initiate field treatment.

Because the pressure inside a commercial jet aircraft flying at 30,000 ft (9,150 m) is equivalent to an unpressurized environmental altitude of 8,000 ft (2,440 m), a diver should not fly for 24 hours following a scuba dive. When transporting a victim of decompression sickness, it is recommended that you use an aircraft that can be pressurized to 1 atmosphere (such as a Lear jet, Hercules C-130, or Cessna Citation), or keep the flight altitude (in an unpressurized aircraft) below 1,000 ft (305 m).

The Divers Alert Network at Duke University Medical Center (919-684-4326 collect or 919-684-8111 toll) provides a 24-hour hotline to assist in the management of all significant diving accidents, as well as evacuation to a facility with a hyperbaric chamber.

NITROGEN NARCOSIS

When absorbed into the bloodstream in sufficient concentration, nitrogen acts as an anesthetic agent. Thus, at depths that exceed 90 ft (27 m), divers are at risk for euphoria, confusion, inappropriate judgment, and unconsciousness induced by nitrogen absorbed into the bloodstream from air breathed under pressure. The treatment is prompt (but cautious) ascent, to allow the absorbed levels of nitrogen to decrease. *No one should ever dive alone. Always pay attention to your dive buddy's behavior. If he acts in a strange manner, assist him to the surface.*

EAR SQUEEZE

As a diver descends in the water, the external water pressure on his eardrum increases rapidly. If he cannot equalize this pressure from within by forcing air into the eustachian tube (a small passageway that connects the middle ear and the throat) and into the middle ear, the eardrum stretches inward (extremely painful)

and then ruptures (Figure 217). This rupture allows water to rush into the middle ear, with resultant severe pain, hearing loss, vertigo (see page), nausea, vomiting, and disorientation. If the diver cannot make his way to the surface, he may drown. If the eardrum is injured but not ruptured, the pain is similar to that of an ear infection. In this situation, the eardrum is intact, but tissue fluid and blood have collected in the middle ear, partially or completely filling it. In addition to pain, the victim notes decreased hearing, and a sense of fullness in the ear. If this occurs, diving should be prohibited (see below) and the person treated with decongestants and, in a severe case, with prednisone (begin with 60 mg first dose for an adult and decrease by 10 mg each day for 5 days) to decrease inflammation.

Inability to “clear” the ears (equalize pressure from within) to prevent inward bulging and rupture of the eardrum should keep a diver out of the water. A person with an upper respiratory tract infection (and narrowed eustachian tube) should not dive, and should avoid travel in an unpressurized aircraft.

If a diver suddenly feels pain in his ear and is stricken with dizziness, nausea, or visual difficulty, he should remain calm and slowly ascend to the surface. The ear should be allowed to drain and dry on its own. Do not insert cotton swabs into the ear, because you may poke the eardrum and increase the damage. Do not instill any medicines into the ear, unless you are carrying ofloxacin otic solution 0.3% or Cortisporin suspension (*not* “solution”). Transport the victim to an ear specialist. Suspend all diving activities until the eardrum is healed or repaired. If dizziness is profound, administer a drug(s) for motion sickness (see page 440). The victim should be started on an antibiotic (ciprofloxacin, trimethoprim-sulfamethoxazole, or doxycycline) to oppose *Vibrio* bacteria. If one of these antibiotics is not available, use amoxicillin-clavulanate. An oral or topical nasal decongestant (such as 0.5% oxymetazoline) is useful for the first few days after the episode. Because sudden dizziness may also be due to an air embolism or the bends, the victim should be observed closely for worsening of his condition.

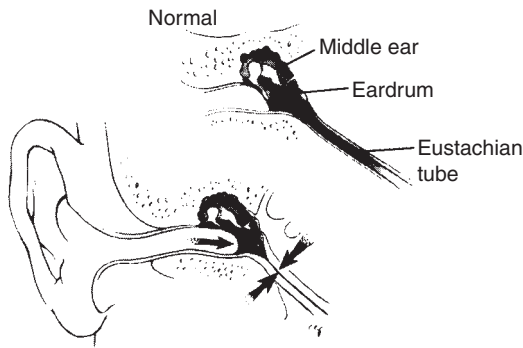


Figure 217. Middle ear squeeze. When a diver descends, air in the middle ear contracts, the eustachian tube collapses, and the eardrum bulges inward, causing pain. If the external water pressure is sufficient, the eardrum can rupture.

Alternobaric vertigo refers to a condition where the pressure in the middle ear can be different between the two ears, usually on ascent. This may cause a person to suffer from vertigo of relatively short duration, ringing in the ears, and hearing loss. The treatment is patience until the pressures in middle ears equalize; decongestants may help hasten the process.

SINUS SQUEEZE

Sinus squeeze occurs if pressurized air cannot be forced into the sinuses during descent. In such a case, the air within the sinus contracts, causing the walls of the sinus to bleed, accompanied by intense, sharp pain. Symptoms include pain over the affected sinus, in the upper teeth (when the maxillary, or cheek, sinus is involved), and nosebleed. A “reverse squeeze” occurs during ascent, when air expands in the sinus without being able to escape. This is also very painful, but fortunately self-limited, because the air will be absorbed slowly into the tissues that line the sinuses.

If a sinus squeeze occurs, slowly ascend to the surface. This generally alleviates most of the pain, but it may take a while for the bleeding to stop. Because the sinus may now be blood-filled, the victim is at high risk for developing sinusitis (see page 194) and should be placed on amoxicillin-clavulanate or azithromycin for 4 days, along with oral and nasal decongestants to promote drainage. If the pain is severe and persists for more than 12 hours after the initial incident, the victim may benefit from a short course of prednisone: 60 mg the first day, 40 mg the second, and 20 mg the third. This combats the inflammation, but should not be given if the victim has symptoms of a sinus infection (foul nasal discharge, fever, facial tenderness).

TOOTH SQUEEZE

Increasing pressure during descent into the water can cause entrapped gas in the interior of a tooth or in the structures surrounding a tooth to contract. In an extreme case, this can cause a tooth to crack or implode. Conversely, air under a filling or within a cavity or abscess can expand on ascent, causing a minor (and painful) “explosion.” To minimize the risk of a tooth squeeze, do not enter the water for at least 24 hours after dental treatment.

DROWNING (SUBMERSION/IMMERSION INTO LIQUID)

One of the most common tragic accidents, particularly of children, is drowning. This can occur in a variety of settings, but the problems encountered seldom vary:

1. Lack of oxygen. If death occurs during the drowning episode, it is most likely because of suffocation due to being submerged or immersed in

water. Another factor is spasm of the vocal cords, which blocks the passage of air through the windpipe (most commonly seen in cold-water drowning). When submerged, the body is starved of oxygen, which is essential to survival. If the submersion lasts long enough, the victim loses consciousness and ultimately suffers a cardiac arrest. If death occurs in a delayed fashion, it is because the lung tissue is injured by water, and oxygen transfer into the bloodstream is inhibited, which commonly leads to brain injury and other organ failure.

2. Body chemistry abnormalities. Because of the lack of oxygen delivery to the organs and tissues of the body, there is rapid accumulation of waste products that cannot be effectively removed. This results in an accumulation of acid and other chemicals that alter the function of the heart, brain, kidneys, liver, and so on.
3. Accompanying problems, such as hypothermia (see page 305), injuries, and serious illnesses (for example, heart attack or stroke). Sadly, alcohol figures prominently in adult boating and drowning accidents.

If a drowning incident occurs, do the following:

1. Remove the victim from the water, while ensuring that you and others remain safe. If immediate rescue is difficult or impossible, and at the earliest opportunity, send someone for help.
2. Check for breathing by feeling over the mouth and nose while watching the chest rise. Open the mouth and sweep it clean with two fingers. Align the victim on the ground with his head at a level below his feet. Begin mouth-to-mouth or mouth-to-mouth-and-nose (for a child) breathing, if necessary (see page 29).
3. Check for pulses and begin chest compressions if necessary (see page 32).
4. Suspect a broken neck in the appropriate circumstances. For instance, someone who has been seen to collapse in a swimming pool probably hasn't broken his neck. (If he dove into the pool, that's another story!) However, someone who tumbles into the waves off a surfboard and washes up unconscious onto the beach may well have a neck injury. Do what is necessary to aid the victim, but remember to protect his neck (see page 37).
5. The Heimlich maneuver (see page 27) is not recommended for use in the rescue of drowning victims, because it may cause the victim to regurgitate and inhale his or her vomit. A few rescuers have observed that if the victim is nonbreathing and in the water, where mouth-to-mouth breathing is difficult or impractical, a few brisk "hugs" applied to the chest (*not* the stomach) may stimulate the victim to cough and begin breathing on his own.
6. Hypothermia (see page 305) is commonly associated with drowning. Cover the victim above and below with blankets. Gently remove all wet clothing. Because hypothermia may be protective for the heart and brain (with regard to lack of oxygen) to a considerable degree, if the victim is

cold, continue the resuscitation until trained rescuers arrive or until you are fatigued. Remember, “no one is dead until he is warm and dead.”

7. If the victim responds to your measures, he should be transported to an emergency facility. Even if he feels 100% normal, he should still be evaluated by a physician, because delayed worsening of lung function is possible. A person who is already short of breath and coughing may deteriorate quickly.
8. Administer oxygen (see page 431) at a flow rate of 10 liters per minute by face mask.

Prevention of Drowning

1. Watch your children. Toddlers are at greatest risk for near-drowning.
2. Fence in all pools and swimming areas. Maintain the water level in a pool as high as possible to allow a person who reaches the edge to pull himself out.
3. Teach children to swim, but be advised that such teaching does not “drown-proof” a child. In other words, never let a small child out of your sight when he or she is near the water, even if they know how to swim. In a drowning situation, they may not have the body strength, judgment, or emotional reserve to allow self rescue. Furthermore, new swimmers and children may have a false sense of security and take undue risks after being taught how to swim.
4. Never place nonswimmers in high-risk situations: small sailboats, whitewater rafts, inflatable kayaks, and the like.
5. When boating or rafting, always wear a properly rated life vest with a snug fit and a head flotation collar. In a kayak or raft traversing whitewater, wear a proper helmet.
6. Do not mix alcohol and water sports.
7. Know your limits. Feats of endurance and demonstrations of bravado in dangerous rapids or surf are for idiots.
8. Be prepared for a flash flood. In times of unusually heavy rainfall, stay away from natural streambeds, arroyos, and other drainage channels. Use a map to determine your elevation, and stay off low ground or the very bottom of a hill. Know where the high ground is and how to get there in a hurry. Absolutely avoid flooded areas and unnecessary stream and river crossings. Do not attempt to cross a flowing stream where the water is above your knees. Abandon a stalled vehicle in a flood area.



ANIMAL ATTACKS

Most animal attacks are from “man’s best friend,” the pet dog. Other animals that will attack humans, given provocation, include the cat, rat, raccoon, tiger, lion, skunk, squirrel, camel, elephant, bear, alligator, crocodile, bat, wolf, rhinoceros, and hippopotamus. Although there are unique variations to the nature of the wounds created by different animals (in most part related to the size of the animal, types of teeth and claws, and risk of infection), the basic out-of-hospital management of an animal bite or mauling is the same for all creatures.

GENERAL TREATMENT

1. If a person is bitten or mauled by an animal, apply pressure to stop any brisk bleeding, and follow the instructions for management of bleeding and cuts (see pages 54 and 260).
2. It is important to clean the wounds well. Flush any injury that has broken the skin with at least 2 quarts (liters) of disinfected water, scrub with mild soap, and flush again. If you are carrying povidone iodine (Betadine) solution 10% (not soap or scrub); benzalkonium (Zephiran) liquid 1% antiseptic; or, in a pinch, Bactine antiseptic (benzalkonium 0.13%), rinse the wound with one of these for 1 minute (to help kill rabies virus), and then rinse away the solution until there is no discoloration of the wound.
3. Do not tightly sew or tape closed any animal bite, unless it is absolutely essential to allow rescue. If a large tear is present, the wound edges can be held together with tape and wraps (see page 266). Tight closure of a contaminated wound (all animal bites and scratches introduce bacteria into the wound) can lead to a devastating infection. Apply a thin layer of bacitracin or mupirocin ointment or mupirocin cream into the wound.
4. If the victim is more than 5 hours from a physician, administer cefuroxime axetil, dicloxacillin, azithromycin, amoxicillin–clavulanic acid, cefixime, cephalexin, trimethoprim-sulfamethoxazole, or ciprofloxacin with clindamycin. If the bite is from a cat, domestic or wild, administer an antibiotic as soon as possible. If an animal bite becomes infected, the same antibiotics are recommended, with the exception that for cat (domestic and “big” cat) bites, dicloxacillin should be given with penicillin.

SPECIAL CONSIDERATIONS

High-Risk Wounds

Wounds at high risk for infection include bites to the hands and feet, and all puncture wounds (see page 258). These should be rinsed copiously and never cinched shut by any method. Anyone who sustains such a wound should be given antibiotics for 4 days (see step 4 on page 409). Cat, human, and primate bites are enormously prone to infection, and require prompt attention by a physician. In a typical human bite, which occurs when a closed fist strikes an opponent's teeth, the cut extends deeply into a knuckle and inoculates the underlying tendon sheath with saliva and bacteria. As the fist is opened, the wound becomes "closed," and an infection can develop quickly. If a human bite is incurred in this manner, splint the hand in the position of function (see Figure 39) and administer cefuroxime axetil, ciprofloxacin plus erythromycin, or dicloxacillin plus ampicillin for 7 days.

Cat Scratch Disease

Cat scratch disease is most commonly caused by bacteria of the genus *Bartonella*. After the victim is scratched by a cat, commonly on the hand, wrist, or forearm, a reddened or purplish sore forms at the scratch site within a few days. The sore may blister and then settle into an ulcer that remains for days to weeks. Along with the sore, the victim typically complains of swollen lymph glands (nodes) directly upstream from the injury. In the case of a scratch on the hand, these would appear behind the elbow and in the armpit. The swollen nodes are often tender and sometimes matted together. On occasion, they may become severely inflamed, soften, and drain through the skin surface. The victim may also complain of fever and fatigue. Although the response to antibiotics is not consistent, the victim may benefit from azithromycin 500 mg by mouth once a day for 5 days, or from a 5-day course of ciprofloxacin or clarithromycin.

Rabies

Rabies virus infection occurs more frequently in wild than in domestic animals. In some foreign countries where immunization of animals is infrequently practiced, the risk is great even in domesticated animals. The virus is carried in saliva and is transmitted by bite or lick (if the skin is broken). It has been transmitted by bats in caves either by aerosolized saliva or undetected bites. Raccoons, dogs, cats, foxes, coyotes, skunks, wolves, bats, woodchucks, and groundhogs are the most common carriers. Rabies has not been reported in bears. Although rabbits, hares, mice, squirrels, chipmunks, rats, guinea pigs, and ferrets may be rabid, they are rarely involved in the transmission of rabies to humans. Domestic animals such as cattle, horses, and sheep become infected in regions where

skunk or raccoon rabies is found. In developing countries in Asia, Africa, and South and Central America, dogs are the most common carriers.

Animals with rabies show abnormal behavior. In the “furious” phase, they are hyperactive, may have a fever, are overtly aggressive, and salivate excessively. With “dumb” rabies, they appear tired, lack coordination, and may become paralyzed.

Because of rabies risk, all wild animal bites or scratches, and bites or scratches of unregistered or strangely behaving cats and dogs, should be reported to the appropriate public health authority. If the animal is a pet with otherwise normal behavior, it should be observed for 10 days. If the animal is rabid, it will become very ill or die during that time, and its brain tissue can be analyzed for the presence of rabies. If the animal is a pet with unusual behavior, or a captured high-risk wild animal, it should be killed and examined. *If it is a high-risk animal and cannot be captured, it must be presumed to be rabid.*

Immediately scrub an animal bite wound or a wound that has been licked by a potentially rabid animal vigorously with soap and water. If benzalkonium chloride 1% (Zephiran); 10% povidone iodine (Betadine) solution (less effective); or, in a pinch, Bactine (benzalkonium 0.13%) antiseptic is available, one of these should be used to irrigate and deeply swab the wound, since they may kill rabies virus.

If rabies is a consideration, the victim should seek the assistance of a physician, who will determine the need for postexposure rabies vaccination (a series of five injections) and injection of antirabies serum (human rabies immune globulin; as much as possible is injected around the bite wound, and the remainder intramuscularly). A person who has been previously immunized against rabies still needs two booster doses of rabies vaccine after high-risk contact with a rabid animal. In countries (Africa, Asia) where rabies is very prevalent in dogs and cats, the vaccination status of the biting animal should be ignored, because the vaccination may not have occurred or may have been ineffective. Begin postexposure vaccination of the human victim and then discontinue after 10 days if the biting animal is observed to remain healthy during that time period.

Preexposure vaccination against rabies should be administered to people at high risk of exposure (animal handlers, cavers, hunters, and trappers in rabies-endemic areas, along with travelers to certain foreign countries). This is given as a series of three intramuscular injections over 28 days, although a newer 1-week schedule for the injections appears to be quite effective. An intradermal regimen can be used for immunization, but this technique may result in lower antibody level.

The incubation period of rabies ranges from 9 days to more than 1 year, but is usually between 2 and 16 weeks. The first symptoms are fatigue, weakness, anxiety, irritability, fever, headache, nausea and vomiting, sore throat, abdominal pain, and loss of appetite. Some victims complain of numbness and tingling where they were initially bitten. After a few days to 2 weeks, the virus shows its devastating effect on the nervous system, with symptoms of increased agitation, hyperactivity, seizures, hallucinations, uncontrollable behavior, and inability to drink (hydrophobia) because of muscle spasms in the throat. This constellation is called “furious rabies.” With “dumb” rabies, a person becomes progressively

weak, uncoordinated, and paralyzed. Unfortunately, rabies is virtually always fatal, with the terminal events being one or more of coma, respiratory failure, seizures, abnormal heart rhythms, paralysis, and pneumonia.

To avoid rabies, be certain that all pets and livestock are properly vaccinated, do not feed or handle wild animals, do not feed or touch stray animals, avoid sick or strange-acting animals, keep garbage and food (including feed for animals) covered and away from wild animals, do not keep wild animals as pets, do not touch or pick up dead animals, and do not handle bats.

Skunks

In addition to biting a person and inoculating him with rabies virus, a skunk can spray secretions from its anal sacs. The main component of skunk musk is butyl mercaptan, which carries a horrible odor and causes skin irritation, eye redness and temporary blindness, and occasional seizures or loss of consciousness. The odor can be neutralized by strong oxidizing agents, such as household bleach diluted 1:5 with water. This solution can then be washed away with tincture of green soap, followed by a more dilute bleach rinse. An alternative mixture is 1 quart of 3% hydrogen peroxide, $\frac{1}{4}$ cup of baking soda, and 1 tsp of liquid laundry detergent. A surprisingly effective product to neutralize skunk spray odor is Summer's Eve douche (C.B. Fleet Company, Inc.). To "deskunk" an animal, such as a dog, the method is to apply it directly to the fur and work it into the deeper layers by hand. It may take many bottles to accomplish the task. For the animal's face, use a washcloth with the solution to apply the product. Tomato juice has been recommended, but may not be very effective, to deodorize hair, which may need to be bleached or cut short. Two other methods that have been recommended (but which I have not personally attempted) are:

1. Fels Naphtha soap. Wet an affected dog with water and rub it down with the soap. Be sure to rinse the animal well.
2. One box of baking soda. Slightly moisten the animal and then rub the fur thoroughly with the baking soda, using gloved hands. Then, take a bottle of white household vinegar—keeping vinegar far away from eyes, nose, and mouth of the animal—and pour it directly onto the baking soda impregnated coat. The immediate and violent effervescence is supposed to lift out the musk and odor. Spray or otherwise rinse the animal thoroughly after allowing for full interaction between baking soda and vinegar.

Bubonic Plague

Cases of bubonic plague are still reported in the United States. The disease is transmitted by the bites of fleas that have acquired the plague bacillus, *Yersinia pestis*, from infected squirrels, rats, prairie dogs, chipmunks, marmots, rabbits,

and mice. Rarely, the disease can be contracted from direct contact with infected pets, particularly cats. It can also be contracted from skinning an infected wild animal, such as a coyote or bobcat.

The incubation period for bubonic plague is 2 to 6 days after exposure. At first, the victim complains of high fever, chills, severe fatigue, abdominal pain, vomiting, diarrhea, muscle aches, and headache. At the same time, he develops extremely enlarged and tender lymph nodes associated with the entry point for the disease, such as in the groin if an insect bite has occurred on the leg. Thereafter, as the bacteria overwhelm the victim, he may collapse and develop a skin rash with large dark patches of hemorrhage ("Black Death"). If pneumonia develops, the victim coughs bloody sputum.

Treatment should be initiated promptly, and requires intramuscular or intravenous antibiotics. If you are isolated away from a hospital, start the victim on tetracycline 1 g for the first dose, then 50 mg/kg (2.2 lb) of body weight in six divided doses every 4 hours for the first day, then 30 mg/kg of body weight in four divided doses every 6 hours for 14 days. This is extremely suboptimal therapy; the victim needs to get to a hospital as soon as possible. The best available drug is streptomycin, which is administered by intramuscular injection.

The disease is contagious. All adults in direct face-to-face contact with a victim suffering from plague pneumonia (cough productive of sputum) should take tetracycline 500 mg four times a day, or trimethoprim-sulfamethoxazole one double-strength tablet twice a day, for 8 days. Children should take a pediatric dose of trimethoprim-sulfamethoxazole for 8 days. All contact people should have their temperature measured twice a day. If anyone develops a fever greater than 100°F (37.7°C), he should begin taking an antibiotic and be taken immediately to a physician.

With regard to prevention, pay attention to local public health warnings and do not travel with pets in areas of plague infestation. Take care to spray or dust your canine and feline companions with flea repellent regularly (after each time they get wet) when traveling in wooded areas. Do not allow children to handle small dead animals.

Preexposure immunization against plague is available (see page 455). If you have not been immunized against plague and will be actively exposed to plague-infected animals, ingest tetracycline 500 mg four times a day during the period of exposure.

Anthrax

Anthrax is a communicable disease caused by *Bacillus anthracis* transmitted by spores via inhalation, ingestion (contaminated meat), or inoculation into the skin. The spores can persist in the environment for years, and are typically present in infected animals or contaminated animal products. Anthrax is not transmitted from person to person. After exposure to the spores, the incubation period is typically 1 to 5 days, although it can be as long as 40 days. With inhalation anthrax,

the victim initially has a nonspecific flu-like illness (fever, fatigue, muscle pains, dry cough, and chest or abdominal pain) followed by severe respiratory distress and overwhelming infection that leads to shock and death. With cutaneous anthrax, the first lesion is usually a painless red raised area on the head, neck, or limb, usually at the site of a small cut or scrape through which the spore enters. In a day or two, a clear blister(s) forms, surrounded by swelling. The blister ruptures, and then turns into an ulcer covered by a black crust in a few days. This disappears in a few weeks. With gastrointestinal anthrax, the victim suffers abdominal pain and swelling, nausea, vomiting, and bloody diarrhea 2 to 5 days after eating the undercooked spore-containing meat. He may also suffer from dizziness, fatigue, muscle aching, and fever. Anthrax may rarely cause primary infection of the lining of the brain, and cause a clinical presentation similar to meningitis (see page 174).

Any adult known to be exposed to anthrax or who is believed to be suffering from anthrax should be administered ciprofloxacin 500 or 750 mg by mouth or doxycycline 100 mg by mouth twice a day until it is determined if the anthrax is susceptible to penicillin or amoxicillin, at which time the antibiotic therapy can be altered. Although ciprofloxacin and doxycycline are usually avoided in children because of potential damage to teeth or bone growth, in the setting of anthrax exposure, the benefits probably outweigh the risks. The pediatric doses are ciprofloxacin 10 to 15 mg/kg of body weight or doxycycline 4.4 mg/kg of body weight daily in two divided doses. Anthrax vaccine can be administered in three doses—on the day of exposure, day 14, and day 28—so antibiotic therapy should be continued for 28 days if the vaccine is administered, and for 60 days if the vaccine is not available.

Hantavirus Pulmonary (Lung) Syndrome

Hantaviruses (such as the sin nombre virus) cause a syndrome characterized by a combination of fever, lung failure, kidney failure, shock, and bleeding. The viruses are spread in the excreta of rodents; in the United States, hantavirus pulmonary syndrome (HPS) has been linked to the deer mouse (*Peromyscus maniculatus*) and white-footed mouse (*P. leucopus*), as well as to the cotton rat (*Sigmodon hispidus*) and rice rat (*Oryzomys palustris*). The animals shed the virus in saliva, urine, and feces. Aerosols are the most likely route of transmission from rodents to humans. Insect bites have not yet been implicated in transmission.

HPS has now been reported in most states west of the Mississippi River, as well as in a few eastern states. In Louisiana and Florida, two hantavirus species, bayou virus and Black Creek virus, have been identified. A person infected by the virus has an incubation period of 1 to 5 weeks after exposure, and then suffers from fever, muscle aches, headache, cough, dizziness, abdominal pain, nausea and vomiting, and diarrhea for a few days; this is followed by difficulty breathing, mottled skin on the limbs, shock, and, sometimes, bleeding. Up to 75% of victims may die.

Most victims have had an interaction with rodents, such as when cleaning a barn or capturing the animals. Unfortunately, there is not yet any specific therapy beyond supportive care, although the antiviral agent ribavirin may prove useful.

To avoid unnecessary exposure to hantavirus, it is recommended that wilderness enthusiasts observe the following precautions: keep food and water covered and stored in rodent-proof containers; dispose of food clutter; spray dead rodents, nests, and droppings with disinfectant before handling (wear gloves); clean and disinfect cabins and other shelters thoroughly before using; don't make camp near rodent sites; don't sleep on bare ground; burn or bury garbage promptly; and use only bottled or disinfected water for campsite purposes.

AVOIDANCE OF HAZARDOUS ANIMALS

Most wild animal encounters can be avoided with caution and a little common sense. Follow these rules:

1. Do not surprise or otherwise provoke animals. Unless they are apex predators, starving, senile, or ill, most animals will not attack humans without provocation. Do not corner or provoke a carnivore. Do not tease animals. Do not approach an animal when it is with young. If you are a photographer approaching a wild animal that may become provoked and charge, do not come any closer to the animal than 100 yards distance. Some experts say that you should attempt to stay even further away from a bear.
2. Do not disturb a feeding animal. Do not explore into its feeding territory, approach during rut, or disrupt mating patterns.
3. Do not separate fighting animals using your bare hands. If possible, drive animals apart using a long stick or club.
4. In bear country, make your presence known by calling out, clapping your hands, or otherwise making noise, particularly when approaching streams and blind spots on the trail. Hang all food off the ground in trees away from the campsite. Never keep food or captured game inside a tent. Use proper food storage to keep food away from bears. Cook at a site away from the sleeping area. Do not sleep in clothes worn while cooking or eating. Make noise when hiking, particularly on narrow paths or through tall grass. If you confront a brown (grizzly) bear, avoid eye contact and try to slowly back away. If you confront a black bear, shout, yell, throw rocks or sticks, or do whatever you can to frighten off the animal. If attacked by a bear, do not try to outrun it; you can't. If you are carrying pepper spray (at least 1% capsaicin or capsaicinoids) in a canister intended for use against a bear ("bear pepper spray" that meets EPA standards; a spray distance of 25 feet under optimum conditions, minimum spray duration of 6 seconds, minimum net content of 7.9 ounces or 2.25 grams), use it if you have time. Personal defensive spray, such as Mace, will likely not work because the canister shoots a relatively thin stream and the substance is not

sufficiently potent. Carry the spray where it is obvious and can be immediately deployed. It should be on a holster on your waist or chest, not in the bottom of your pack. Show your companions its location. If you are not carrying bear pepper spray, cover your head and the back of your neck with your arms and curl into a fetal position or lay flat on the ground, face down, to protect your abdomen. If you are wearing a backpack, keep it on for additional protection. Use your elbows to cover your face if a bear turns you over. After a bear attack, remain on the ground until you are certain that the bear has left the area. More than one victim has successfully protected himself during the initial attack, only to arise too soon (before the bear has lost interest and left the area) and be mauled during the second attack.

5. Never leave a small child alone with an animal, regardless of the animal's demeanor.
6. Do not pet or feed animals (particularly dogs and monkeys).



WILD PLANT AND MUSHROOM POISONING

Toxic plants and mushrooms may be eaten by curious children, or by hikers and amateur herbalists who mistake their selections for edible species. *Never eat wild plants, mushrooms, roots, or berries unless you know what you're doing.* Bees that collect nectar from poisonous plants might theoretically manufacture poisonous honey, but that would be highly unlikely unless all of the bees in the hive collected their nectar from poisonous plants.

MEDICAL HISTORY

Although the narrative description of the ingestion will have little bearing on the immediate management of a toxic ingestion, it is important to gather as much information as possible for the benefit of the physician who will ultimately care for the victim:

1. When was the plant eaten?
2. What parts of the plant were eaten? How many different plants were eaten?

3. What symptoms does the victim have? What were the initial symptoms (sweating, hallucinations, vomiting, abdominal pain)? What was the time interval between the ingestion and the onset of symptoms? Did anyone who did not eat the plant(s) develop similar symptoms? Did everyone who ate the plant(s) become ill?
4. Was the plant eaten raw, or was it cooked? How was it cooked? Was alcohol consumed within 72 hours of the plant ingestion?

It is also important to obtain as much of the original plant as possible for identification. If the patient vomits, save his vomitus, because it may contain part of the plant or spores that can be identified by an expert.

There are few specific antidotes for toxic plant ingestions, so most victims are managed according to their symptoms, which may include sweating, nausea, vomiting, diarrhea, shortness of breath, slow or rapid heartbeat, pinpoint or dilated pupils, salivation, increased frequency of urination, weakness, difficulty breathing, hallucinations, and many others.

TREATMENT FOR POISONINGS

If it is known that someone has ingested a toxic plant or mushroom within the last 2 hours, he should immediately be forced to vomit (if he has not already done so). This may be done by administering syrup of ipecac (adult or child older than 6 years—dose 2 tsp, or 30 mL; pediatric dose, age between 12 months and 6 years, 1 tsp, or 15 mL, followed by at least a pint (473 mL) of warm water ($\frac{1}{2}$ pint, or 237 mL, for a small child). If ipecac is not available, have the victim ingest 2 tsp (15 mL) of dishwashing soap, such as Ivory or Joy (not automatic dishwasher soap), followed by the water. If the victim is drowsy, do not induce vomiting. After vomiting is induced, immediately seek the attention of a physician.

Children will eat just about anything. Nontoxic ingestions include stones, dirt, sand, candles, sunscreen, shampoo, and single doses of birth control pills, antacids, laxatives, and vitamins (without iron). Keep all toxic substances, particularly camp-stove fuel, kerosene, iodine crystals (for water disinfection), and prescription drugs, out of the reach of small children.

COMMONLY INGESTED TOXIC PLANTS AND MUSHROOMS

1. Oleander (Figure 218) is a shrub, up to 20 ft (6 m) tall, commonly found along highways and in gardens. It carries attractive clusters of red, pink, or white flowers. The entire plant is toxic, including smoke from burning cuttings and water in which the flowers are placed. There have been deaths from use of the branches as skewers for roasting hot dogs. Symptoms begin 1 to 2 hours after ingestion and include nausea, vomiting, abdominal



Figure 218. Oleander.

cramps, diarrhea, confusion, and blurred vision. In serious ingestions, the heart's rhythm may be disturbed.

2. Foxglove (Figure 219) is a European import that has toxic leaves and toxic tubular pink or purple flowers. Poisonings occur from ingestion of the plant parts or from foxglove tea. The symptoms are the same as those of oleander ingestion.
3. Water hemlock ("beaver poison") (Figure 220) is found in saltwater and freshwater marshes and along riverbanks. A member of the carrot family, the plant grows to 6 ft (1.8 m) and has clusters of whitish, heavily scented flowers, along with a bundle of tuberous roots. It is easily confused with wild parsnip, celery, or sweet anise. When injured, the stem and trunk exude



Figure 219. Foxglove.



Figure 220. Water hemlock, with tuberous roots.

a yellow oil that smells like celery or raw parsnip. The entire plant is toxic. Symptoms begin 15 to 60 minutes after ingestion and include excessive salivation, abdominal pain, diarrhea, and vomiting. In a serious ingestion, the victim may suffer seizures and collapse, while having difficulty breathing. Death may occur.

4. Castor bean (Figure 221) is a treelike shrub that may grow to 15 ft (4.6 m) with clusters of spiny seedpods, which contain seeds with coats that resemble pinto beans. The seeds contain a potent toxin (ricin) that causes immediate mouth burning and abdominal pain, followed by vomiting, diarrhea, abnormal heart rhythms, and collapse.
5. Monkshood (Figure 222) is a flowering plant with tuberous roots and blue helmet-shaped flowers. The leaves and roots are particularly toxic. Ingestion causes immediate mouth and throat burning, followed by vomiting, diarrhea, headache, muscle cramps, sweating, drooling, blurred vision, and confusion. In a serious ingestion, there may be abnormal heart rhythms and collapse.



Figure 221. Castor bean.



Figure 222. Monkshood.

6. Poison hemlock (Figure 223) is a marsh plant that grows to 9 ft (2.7 m) with leaves that resemble a carrot top. The white flowers are clustered and smell like urine if they are crushed. The seeds and white unbranched tuberous roots are also toxic. The symptoms are similar to those of water hemlock ingestion, without significant abdominal pain or diarrhea. Death may follow seizures or paralysis with breathing failure.
7. Pokeweed (Figure 224) is a widely distributed plant with clusters of white flowers and plentiful round purple berries. Ingestion of the root (commonly



Figure 223. Poison hemlock.



Figure 224. Pokeweed.

mistaken for horseradish) or the berries (a favorite of children) causes the intoxication. Symptoms include sore mouth, tongue, and throat (delayed by 2 to 3 hours); thirst; nausea; vomiting; abdominal cramps; and diarrhea, which may become bloody. The illness can be severe and last for up to 2 days, particularly if the roots were ingested.

8. Rhododendrons (Figure 225) are common flowering plants that contain a number of toxins. Poisoning has occurred following ingestion of honey made from the flower nectar. Symptoms include mouth burning, followed by drooling, vomiting, diarrhea, headache, and numbness and tingling. Serious ingestions cause weakness, blurred vision, seizures, and collapse.
9. Jimsonweed (Figure 226) has white or purple flowers, with prickly seed-pods. Adults sometimes ingest a tea made from the leaves or flowers. The entire plant is toxic. Symptoms include dry mouth, rapid heartbeat, hot and dry skin, weakness, difficulty walking, dilated pupils, and inability to urinate. Severe poisonings cause fever and collapse.
10. Skunk cabbage (Figure 227) is a marsh and forest plant that grows to 6 ft (1.8 m) and has broad pleated leaves. The entire plant is toxic and causes symptoms similar to those that follow ingestion of monkshood, but generally much less severe.



Figure 225. Rhododendron.



Figure 226. Jimsonweed.



Figure 227. Skunk cabbage.

11. *Pyracantha* (Figure 228) is a thorned shrub with white flowers and clusters of small red berries. Ingestion of the berries in large quantities causes nausea and diarrhea. Birds sometimes eat fermented pyracantha berries and become intoxicated. Scratches from the thorns may cause a burning skin irritation.
12. *Amanita phalloides* (death cap) is a gilled mushroom (Figure 229) with a shiny yellow to greenish cap found in the western United States. The entire mushroom is toxic and cannot be detoxified by cooking. Symptoms occur 6 to 12 hours after ingestion and include abdominal pain; persistent nausea, vomiting, or diarrhea; low blood pressure; and rapid heartbeat. The victim may appear normal for the next few days, but then rapidly shows signs of massive liver inflammation and destruction, which include jaundice (yellow skin and eyeballs, darkened urine), easy bleeding, and altered mental status. Fatalities are frequent with this species, as well as with *Galerina autumnalis*.



Figure 228. *Pyracantha*.



Figure 229. *Amanita phalloides* (death cap).

Most nonfatal mushroom toxins act rapidly, producing symptoms of nausea, vomiting, diarrhea, and headache within 1 to 4 hours. Severe abdominal pain and headache approximately 6 hours after ingestion are likely due to *Gyromitra esculenta*. Typically, diarrhea and vomiting caused by ingestion of *Amanita phalloides* are delayed by 6 to 12 hours. However, because most unknowledgeable mushroom foragers eat a mixture of species, a rapid onset of symptoms does not rule out a potentially disastrous ingestion. Approximately 7 to 10 species of the several thousand varieties of wild mushrooms in the United States can cause death by ingestion.

13. *Amanita muscaria* (fly agaric) is a gilled mushroom (Figure 230) with a variably colored (yellow, red, warty, and so on) cap. Most poisonings are intentional, because people brew and drink *Amanita* tea for its hallucinogenic effects. Symptoms occur 30 minutes to 2 hours after ingestion and include

euphoria, difficulty walking, dizziness, hallucinations, and blurred vision. Severe ingestions can result in seizures and death.

14. *Coprinus atramentarius* (inky cap) is a gilled fungus (Figure 231) with a conical cap that liquefies and turns black when picked. If alcohol is consumed within 24 to 72 hours after ingestion of the fungus, the victim suffers abdominal pain, vomiting, sweating, facial flushing, and headaches. *Cortinarius rainierensis* may cause the victim to have enormous thirst and increased urination 3 to 17 days after ingestion, due to a toxic effect on the kidneys.

Many other plants (wild and houseplants) can cause illnesses if consumed in sufficient quantities (one apple seed will not poison you). When in doubt as to the identity of a plant ingested, its quantity, or its potential toxicity, it is wisest to immediately consult a certified poison (control) center or a physician.



Figure 230. *Amanita muscaria* (fly agaric).



Figure 231. *Coprinus atramentarius* (inky cap).

TOXICITY OF COMMON PLANTS

The following list divides common plants into four groups:

T: TOXIC

O: TOXIC OXALATE (plant juices contain oxalates; ingestion may cause irritation of the mouth and throat, nausea, diarrhea, and difficulty breathing)

I: IRRITANT (ingestion may cause abdominal pain, nausea, vomiting, and diarrhea; contact with the skin may cause irritation)

N: NONTOXIC

- Acorn (T)
Akee unripe fruit (T)
Algerian ivy (I)
Alocasia (O)
Aloe vera (I)
Amaryllis, common (I)
American ivy (O)
Amorphophallus (O)
Angel's-trumpet (T)
Anthurium (O)
Apple pits (T)
Apricot pits (T)
Aralia (N)
Arnica flowers and roots (T)
Arrowhead vine (O)
Asparagus fern (N)
Asparagus fern berries (I)
Autumn crocus bulbs (T)
Avocado leaves (T)
Azalea (T)
Baby's breath (N)
Bamboo palm (N)
Baneberry berries, roots, stalk,
and sap (T)
Barberry (I)
Beaver poison (T)
Beechnut seeds (I)
Begonia (N)
Belladonna (T)
Betel nut seeds (T)
Bird-of-paradise seeds and pods (I)
Bird's-nest fern (N)
Bittersweet (T)
Black alder berries (I)
Black cherry bark, leaves,
and seeds (T)
Black locust (I)
Black nightshade leaves
and green fruit (T)
Bleeding heart (T)
Bloodroot (T)
Blue cohosh (T)
Boston ivy (O)
Boxwood leaves and twigs (I)
Buckeye flowers, seeds, and nuts (T)
Buckthorn (T)
Bull nettle green fruit (T)
Bunchberry (I)
Burning bush (T)
Buttercup (T)
Cactus thorn (I)
Calabar bean (T)
Caladium (O)
California poppy (N)
Calla lily (O)
Camellia (N)
Cardinal flower (T)
Carnation (I)
Cassava root (T)
Cast-iron plant (N)
Castor bean seeds (T)
Celandine (I)
Century plant (I)
Cherry pits (T)
Chinaberry (T)
Chinese evergreen (N)
Chokecherry (T)
Christmas rose (T)
Chrysanthemum (T)
Clematis (T)
Climbing lily (T)
Coffee senna (I)
Coffee tree (N)
Coleus (N)
Colocasia (O)
Coralberry (I)
Corn cockle seeds (T)
Cornstalk plant (N)
Cotoneaster (T)
Cowbane (T)
Crape myrtle (N)
Creeping Charlie (T)
Crocus: autumn, meadow (T)
Croton (N)
Croton seeds (T)
Crowfoot (T)
Crown of thorns (I)
Cyclamen (I)
Daffodil bulbs (I)
Dahlia (N)
Daisy (I)
Daphne (T)

- Deadly nightshade (T)
Death camas bulbs and roots (T)
Delphinium (T)
Desert rose (T)
Devil's ivy (O)
Dieffenbachia (O)
Dogwood (N)
Donkey's-tail (N)
Dracunculus (O)
Dragon tree (N)
Dumb cane (O)
Dutchman's breeches (T)
Easter cactus (N)
Easter lily (N)
Elderberry (T)
Elephant's ear (O)
Emerald duke (O)
Emerald ripple (N)
English ivy (I)
European bittersweet (T)
European spindle tree (T)
False hellebore (T)
Fava beans and pollen (T)
Fetterbush (T)
Fiddle-leaf fig (N)
Fig tree (N)
Fishberry dried fruit (T)
Fishtail palm (O)
Fool's parsley (T)
Forget-me-not (N)
Forsythia (N)
Four-o'clock roots and seeds (I)
Foxglove (T)
Fuchsia (N)
Garden sorrel (O)
Gardenia (N)
Geranium, California (I)
Glacier ivy (I)
Gloriosa (T)
Glory lily (T)
Gloxinia (N)
Golden-chain tree (T)
Goldenseal (T)
Golden-shower (I)
Grape ivy (N)
Groundsel (T)
Hawaiian ti plant (N)
Hawthorn berries (N)
Heart ivy (I)
Heart leaf (O)
Hemlock tree (N)
Henbane, black (T)
Hibiscus (N)
Holly berries (I)
Honeysuckle berries (N)
Horse beans and pollen (T)
Horse chestnut (T)
Horse nettle green fruit (T)
Hyacinth bulb (I)
Hydrangea (T)
Ice plant (N)
Indian tobacco (T)
Inkberry (T)
Iris roots (I)
Jack-in-the-pulpit (O)
Jade plant (N)
Jasmine (N)
Jequirity bean (T)
Jerusalem cherry leaves
and unripe fruit (T)
Jessamine (T)
Jimsonweed (T)
Jonquil bulbs (I)
Kentucky coffee tree (I)
Laburnum leaves and seeds (T)
Lady's slipper (N)
Lantana (T)
Larkspur (T)
Laurel, American (T)
Laurel, black (T)
Laurel, English (T)
Laurel, mountain (T)
Laurel, sheep (T)
Lichen (T)
Lily-of-the-valley (T)
Lipstick plant (N)
Lupine (T)
Maidenhair fern (N)
Majesty (O)
Manchineel fruit (I)

- Mandrake (I)
Mango skin and sap (I)
Marble queen (O)
Marigold, cowslip (I)
Marijuana (T)
Marsh marigold (T)
Mayapple (I)
Meadow saffron (T)
Mescal (T)
Mexican jumping bean (T)
Mexican prickly poppy seeds and oil (T)
Mimosa (T)
Mistletoe berries (T)
Monkeypod nuts (I)
Monkshood (T)
Moon cactus (N)
Moonseed roots and fruit (I)
Morning glory seeds (T)
Mother-in-law's-tongue (N)
Mother-of-pearl (N)
Mountain ash berries (N)
Mountain laurel (T)
Mulberry, red (green berries and sap) (T)
Narcissus bulbs (I)
Nephthytis (O)
Nerve plant (N)
Nightshade (T)
Norfolk Island pine (N)
Nutmeg seeds (T)
Old man cactus (N)
Oleander leaves (T)
Olive tree (N)
Orchid (N)
Oregon grape (N)
Pansy flowers (N)
Paradise palm (N)
Parlor ivy (O)
Parlor palm (N)
Passion vine (N)
Peach pits (T)
Peanut cactus (N)
Pear pits (T)
Pellionia (N)
Peony flower (N)
Peperomia (N)
Periwinkle (T)
Petunia (N)
Peyote (T)
Pheasant's eye (T)
Philodendron (O)
Phlox (N)
Physic nut seeds (T)
Plum pits (T)
Poinsettia (I)
Poison hemlock (T)
Poison ivy (I)
Poison oak (I)
Poison sumac (I)
Pokeberry (T)
Pokeweed (T)
Potato (except tuber) (T)
Pothos (O)
Prayer bean (T)
Privet: common, California (T)
Pussy willow (N)
Pyracantha (I)
Rabbit's foot fern (N)
Ragwort (T)
Rainbow plant (N)
Red sage (T)
Rhododendron (T)
Rhubarb leaves (O)
Ripple ivy (I)
Rosary bean/pea (T)
Rose (N)
Rubber plant (N)
Scotch broom seeds and leaves (T)
Sentry palm (N)
Shamrock plant (O)
Skunk cabbage (O)
Snakeberry berries, roots, stock, and sap (T)
Snakeroot, white (T)
Snapdragon (N)
Snowberry berries (I)
Snowdrop (I)
Soapberry (I)
Spanish broom seeds and leaves (T)
Spider plant (N)

Sprengeri fern (I)	Walnut, green shells (T)
Squill (T)	Wandering Jew (inch plant) (N)
Staghorn fern (N)	Water arum (O)
Star anise, Japanese (T)	Water hemlock (T)
Star-of-Bethlehem (I)	Wild cherry (T)
Stinkweed (T)	Wild garlic (I)
Swedish ivy (N)	Wild grape roots (T)
Sweet pea (T)	Wild onion (I)
Swiss cheese plant (O)	Wild sage (T)
Sword fern (N)	Wild tobacco (T)
Thorn apple (T)	Wild tomato green fruit (T)
Tobacco, green (T)	Windsor beans and pollen (T)
Tomato leaves (T)	Wintersweet (T)
Toyon leaves (T)	Wisteria pods (I)
Tulip bulbs (O)	Witch hazel (T)
Tung nut seeds (T)	Wood rose (T)
Umbrella plant (T)	Yellow jessamine (T)
Venus's flytrap (N)	Yellow nightshade fruit (T)
Vinca (T)	Yew (T)
Virginia creeper (O)	Yucca (N)
Wahoo (T)	Zinnia (N)

PART FIVE

Miscellaneous Information

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OXYGEN ADMINISTRATION

It may be advisable or necessary under certain circumstances to administer supplemental oxygen gas (O_2) to a person who would benefit from such therapy. Examples include those stricken with severe high-altitude pulmonary edema, acute severe congestive heart failure, decompression sickness (the bends), and so forth. Anyone who may be called on to use oxygen delivery equipment should be properly trained in its use ahead of time.

The equipment required to deliver oxygen includes a medical oxygen cylinder (tank), pressure gauge, pressure-reducing valve, flowmeter, tubing, and nasal cannula (tube) or facemask (with or without a reservoir bag).

Oxygen cylinders in the United States are usually painted green or have distinctive green markings. They come in two practical field sizes: D (20 in, or 50.8 cm, in length; carries 360 liters of oxygen) and E (30 in, or 76.2 cm, in length; carries 625 liters of oxygen). The length of time that oxygen can be delivered is calculated by dividing the tank capacity by the flow rate. For instance, a D cylinder can deliver 10 liters per minute for 36 minutes. To make the oxygen last longer, keep the flow rate to the lowest effective number.

The pressure gauge reading indicates how much oxygen remains in the cylinder. At full capacity, an oxygen tank is pressurized to 2,000 lb per square inch (psi). Thus, when the gauge indicates a pressure of 500 psi, one-fourth of the tank's capacity for oxygen remains. At a reading of 200 psi, a tank is near empty.

The pressure gauge, pressure-reducing valve, and flowmeter combine to create the regulator, which reduces the pressure of the oxygen from that inside the tank to approximately 50 psi. This allows delivery to the victim at flow rates between 1 and 15 liters per minute.

The delivery device attached to the victim is either a two-pronged (one for each nostril) nasal cannula, or a mask, the latter with or without a reservoir bag. A nonrebreather is a mask with a reservoir bag attached by a one-way valve such that the victim can breathe oxygen that is delivered into the bag, but cannot exhale carbon dioxide back into the bag (he cannot "rebreathe" from the bag). The nonrebreather is used to deliver high concentrations (as a percent of inspired air, 80% to 90% oxygen at flow rates of 10 to 15 liters per minute) of oxygen. The reservoir bag should be kept at least half full of oxygen. This can be accomplished with flow rates of 6 liters per minute or greater.

If lesser concentrations of oxygen are adequate or desired, as with a patient who has chronic obstructive pulmonary disease (see page 47), a nasal cannula can be used. The cannula will deliver 25% to 40% oxygen at flow rates of 2 to

6 liters per minute. The nasal cannula is less confining in that the victim can speak, drink, and eat without having to remove a mask.

Since O₂ is dry, it is often desirable to interpose a humidifying device when O₂ delivery will be prolonged.

To administer oxygen:

1. Place the cylinder upright. Open and close the tank valve slowly (“crack the tank”) with a wrench to clean debris from the outlet.
2. Close the regulator flow valve and attach the regulator to the tank. Tighten securely by hand. Never use a regulator without the proper O-ring fitting. *Never use tape to hold a loose regulator in place.*
3. Open the tank valve slowly to half a turn beyond where the regulator becomes pressurized and there is a maximum reading on the pressure gauge.
4. Attach the plastic delivery tubing to the regulator outflow nipple. Attach the breathing mask or nasal cannula to the other end of the tubing, if it is not already attached.
5. Open the regulator flow valve to the desired flow rate in liters per minute (LPM). A regulator marking of “low” indicates 2 to 4 LPM, “medium” is 4 to 8 LPM, and “high” is 10 to 15 LPM. The flow rate for a nonrebreather mask should not be less than 6 LPM; the flow rate for a nasal cannula should not be more than 6 LPM.
6. Position the mask or cannula on the victim’s face. Adjust for comfort. Observe the victim to be certain that the device is tolerated, and that the reservoir bag fills properly.

PRECAUTIONS

1. Never allow an open flame near an oxygen-delivery system.
2. Do not expose an oxygen tank to excessive heat (above 125°F, or 52°C) or freezing cold.
3. Do not position any part of a person directly over a tank valve—a loose regulator can be blown off the top of the cylinder with tremendous force.
4. Do not drop a cylinder; do not roll a cylinder.
5. Close all valves when the cylinder is not in use.



WATER DISINFECTION

Water *purification* is the removal of chemical pollutants by filtration through activated charcoal or active resin compounds. This usually improves the taste, but does not decrease the incidence of infectious disease, because microorganisms are not removed. Water *disinfection* is the treatment of water with chemicals, boiling, or filtration to remove agents of infectious disease, such as bacteria and cysts. *Sterilization* is the removal of all life forms.

If at all possible, carry disinfected water with you. If you must drink water from a stream or lake that you cannot disinfect, try to use small tributaries that descend at right angles to the main direction of valley drainage. Clean melted snow is of less risk than ice taken from the surface of a lake or stream. Most bacteria that cause diarrhea can survive for months in ice.

The principal offending agents in contaminated water or on unwashed food that cause illness and diarrhea are the bacteria *Salmonella*, *Shigella*, *E. coli*, and *Campylobacter*, and the flagellate protozoan *Giardia lamblia* (see page 207). Drinking nondisinfected water in parts of Africa, India, and Pakistan can cause dracunculiasis (guinea worm disease). In countries where water is improperly disinfected, stick to bottled or canned carbonated beverages, beer, and wine. However, be advised that even bottled water in developing countries can be contaminated with bacteria that cause diarrhea, so even bottled water should probably be boiled or disinfected with chemicals or ultraviolet (UV) light before drinking. All containers should be wiped clean to remove external moisture and dirt. All ice should be considered contaminated. For purposes of preserving the environment, it is preferable to carry a reusable water container that is filled with disinfected water than to discard multiple plastic or glass containers.

Do not urinate or defecate (inadvertently) into or near your water supply. Build a latrine 8 to 10 in (20 to 25 cm) deep into the ground at least 100 ft (31 m) and downhill from the water supply. Try to keep the latrine away from a gully or other formation that might become a runoff stream during a thaw or after heavy rainfall.

“Raw” drinking water should be allowed to rest for several hours in order for large particles to settle to the bottom. The top portion can be poured off, if possible, through a filter or fine cloth. Coagulation and flocculation techniques remove smaller suspended particles. Add a pinch of alum (an aluminum salt) to a gallon (3.8 liters) of water and mix well, then stir occasionally for 60 minutes. Allow the water to rest while the aggregated particles settle, and then pour off the upper (hopefully clearer) part through a paper filter (such as a laboratory-grade filter with a pore size of 20 to 30 microns).

Water may be disinfected by any of the following methods:

1. The usual advice—to boil water for 5 to 10 minutes plus 1 minute for each 1,000 ft (305 m) of altitude above sea level—is probably overkill.

Giardia cysts are instantly killed in water heated to 158°F (70°C). To play it safe, bacteria and most viruses require a few minutes at this temperature. Hepatitis A virus requires a full minute of boiling to ensure inactivation.

Time and temperature have an inverse relationship with respect to water disinfection: The higher the temperature, the less time is required, and vice versa. For instance, pasteurization of food products can occur at a lower temperature (158°F, or 70°C) if 30 minutes at this temperature are allowed. Sterilization (killing of all microorganisms) occurs after 5 to 10 minutes of boiling at sea level.

The temperature at which water boils varies with altitude because of the surrounding barometric pressure. Barometric pressure is expressed in terms of the height (in inches or millimeters) of a column of mercury (Hg) that exerts a pressure equal to that of a column of air with the same size base. At sea level (barometric pressure 760 mm Hg), water boils at 212°F (100°C); at 5,000 ft, or 1,525 m (632 mm Hg), 203°F (95°C); at 10,000 ft, or 3,050 m (522 mm Hg), 194°F (90°C); at 14,000 ft, or 4,270 m (446 mm Hg), 187°F (86°C).

Thus, boiling water is effective for disinfection at any altitude below 18,000 ft (5,490 m) likely to be attained by a wilderness enthusiast. The time required to heat the water to boiling contributes to the disinfection process. To provide a wide margin of safety, boil the water for 3 minutes.

Halogens, such as iodine and chlorine, are effective chemical disinfectants. The rate at which they kill microorganisms depends on the concentration (measured in mg per liter, or parts per million [ppm], which are equivalent) of halogen and time allowed for disinfection. At a given water temperature and pH, contact time is inversely related to concentration. Thus, you double the contact time if half the concentration of halogen is present. Decreased (cold) water temperature or cloudy (more organic material) water requires a longer contact time or higher halogen concentration. Halogens can create an unpleasant taste if the concentration exceeds 4 mg/liter. They can lose effectiveness after prolonged exposure to moisture, heat, or air, and may be corrosive or stain clothing. In general, to improve taste, use a lower concentration of halogen for a longer contact time. Eight mg/liter (or ppm) is considered the concentration of iodine effective for water disinfection in room-temperature, clear water. A pregnant woman or a person with thyroid disease or iodine allergy should consult a physician before using any iodine compound for water disinfection.

Water disinfection tablets, such as Potable Aqua (see below) and other iodine- and chlorine-based products, may be used inside plastic hydration bladders, such as those found in the CamelBak. While they may discolor the plastic, they do not degrade it.

2. Add one tablet of fresh tetraglycine hydroperiodide (Potable Aqua, Globaline, Coughlan's, EDWGT) to 1 quart (liter) of water and allow the water to stand for 15 minutes. If the water is cloudy, use two tablets. If the water is cold, allow 1 hour after adding the tablets before drinking. Each tablet releases approximately 8 mg/liter of iodine. Do not leave an open bottle exposed to high heat and/or humidity. Potable Aqua Plus includes oxidizing tablets to remove the iodine taste after disinfection.

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	1 tab for 15 minutes	2 tabs for 30 minutes
cold	1 tab for 60 minutes	2 tabs for 60 minutes

After adequate time for disinfection has elapsed, add a few grains of sodium thiosulfate per quart (liter) of water; this kills the iodine taste. Ascorbic acid (vitamin C) is also effective. Any fruit flavorings that contain vitamin C should be mixed in after full time for disinfection has elapsed. Potable Aqua Plus treatment includes an oxidizing tablet to remove the iodine taste. Granular activated charcoal removes organic material, chemicals, and radioactive particles by adsorption, but does not remove all microorganisms, and thus cannot be relied on to disinfect water. Rather, it should be used to improve taste and clarity. Use it after water has been properly disinfected.

Zinc metal reduces free chlorine or iodine in solution through a chemical reaction. A wand of zinc bristles stirred into a quart (liter) of water for 4 minutes will remove 10 mg/liter of residual chlorine.

Because a 50-tablet bottle of tetraglycine hydroperiodide contains only 0.4 g of iodine ($1/50$ the lethal dose), the tablet method is very safe.

If you use military surplus iodine tablets, they should be steel gray in color and not crumble when pinched by two fingers; discard older, crumbled tablets. Also, no matter what chemical disinfection system you use, allow disinfected water to seep around the cap and threads of your canteen or water bottle, to disinfect them.

3. Add 8 to 10 drops (0.5 mL in each drop) of standard 2% iodine tincture per quart (liter) of water and allow it to stand for 15 minutes. Use a dropper for measurement. If the water is not at least 68°F (20°C), this technique may not eliminate *Giardia*. If the water is cold, allow it to stand for 1 hour before drinking. If you have extra time and do not like the iodine taste, use four to five drops of iodine and allow the water to stand for 8 hours or overnight. Five drops of tincture of iodine disperses to approximately 4 mg/liter.

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	5 drops for 15 minutes	10 drops for 30 minutes
cold	5 drops for 60 minutes	10 drops for 60 minutes

Another iodine product that can be used to disinfect water, but has not definitively been proven effective for this purpose, is 10% povidone- iodine (Betadine) solution (not “scrub”):

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	8 drops for 15 minutes	16 drops for 30 minutes
cold	8 drops for 60 minutes	16 drops for 60 minutes

4. Fill a 1 oz (30 mL) glass bottle with iodine crystals (U.S. Pharmacopeia [USP] grade, resublimed: 2 to 8 grams), and then fill the bottle with water. The bottle should have a paper-lined Bakelite cap. Warm the water to 68°F to 77°F (20°C to 25°C). Shake vigorously, and then allow the crystals to settle to the bottom for 1 hour. This will create a saturated solution of iodine. As a crude measure, pour at least half of this liquid (not the remaining crystals), or approximately 12.5 to 15 mL, through a fine filter (such as Teflon) into a quart (liter) of water and allow it to stand for 30 minutes. If the water temperature is not at least 68°F (20°C), this technique may not eliminate *Giardia*. The crystals may be reused up to 1,000 times. Two grams (0.07 oz) of iodine represents a potentially lethal dose if ingested, so it is absolutely essential to keep the iodine crystals out of the hands of children. A commercial iodine crystal system that can be reused to disinfect up to 2,000 quarts (liters) of drinking water is sold as Polar Pure Water Disinfectant.

If one capful from a 2 oz (59 mL) bottle equals approximately 2.5 mL, then using a saturated solution prepared from iodine crystals in water:

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	5 capfuls for 15 minutes	10 capfuls for 30 minutes
cold	5 capfuls for 60 minutes	10 capfuls for 60 minutes

An alcohol-iodine solution can be prepared by adding 8 g of iodine crystals to 100 mL of 95% ethanol. The resulting supernatant yields 8 mg iodine per 0.1 mL. To add to water, measure with an eyedropper:

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	0.1 mL for 15 minutes	0.2 mL for 30 minutes
cold	0.1 mL for 60 minutes	0.2 mL for 60 minutes

- Filter the water through a category-three (as set for purification by the Environmental Protection Agency) water treatment device. Manufacturers who sell filtration devices are Mountain Safety Research, Katadyn, AquaRain Filter Systems, General Ecology Inc., Recovery Engineering, Timberline, Stearns Outdoors Inc., McNett, and Sawyer Products. The Sawyer Point Zero Two water filter, with a 0.02 micron filter, is rated to remove viruses. This product is available with a bucket adapter kit, or can be fitted to 4 liter bags or a special water bottle.

If the filter doesn't come with a "prefilter" (nylon mesh or screen) to remove large particles, pour the water through filter paper (see below) or fine cheesecloth. This helps keep your expensive water filter from clogging up, allows it to work more efficiently, and will improve the appearance and taste of the water.

- Maximum filter pore sizes (in material or microns) for removing microorganisms are as follows: dracunculus (guinea worm) larvae—coffee filter or fine cloth; schistosome cercariae—coffee filter or fine cloth; parasitic eggs and larvae—20; *Giardia lamblia* cyst, *Entamoeba histolytica* cyst, *Cyclospora*—3 to 5; *Cryptosporidium* oocyst—1; enteric bacteria (such as *E. coli*)—0.2 to 0.4; and viruses—0.004 to 0.01.
- Halazone (a mixture of monochloraminobenzoic and dichloraminobenzoic acids) and other chlorine (bleach) products have been considered less effective for field water disinfection. Halazone has been characterized as losing 75% of activity after 2 days' continuous exposure to air with high heat and humidity; having a shelf life of 6 months; and decreasing potency by 50% after storage above 104°F (40°C). Therefore, you should obtain a new bottle every 3 to 6 months.

Each Halazone tablet releases 2.3 to 2.5 mg/liter of chlorine. To disinfect water:

ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	5 tablets for 15 minutes	7 tablets for 15 minutes
	2.5 tablets for 30 minutes	5 tablets for 30 minutes
cold	5 tablets for 60 minutes	7 tablets for 60 minutes

Liquid bleach (hypochlorite solution; household bleach, usually 5.25%) can be used to disinfect water via chlorination. There should be a faint smell or taste of chlorine before drinking.

FOR 5.25% BLEACH, ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	2 drops (0.1 mL) for 30 minutes	4 drops (0.2 mL) for 30 minutes
cold	2 drops (0.1 mL) for 60 minutes	4 drops (0.2 mL) for 60 minutes

FOR 1% BLEACH, ADD TO 1 QUART (LITER) OF WATER:

water	clear	cloudy
warm ($>15^{\circ}\text{C}$, 59°F)	10 drops (0.5 mL) for 30 minutes	20 drops (1 mL) for 30 minutes
cold	10 drops (0.5 mL) for 60 minutes	20 drops (1 mL) for 60 minutes

8. Superchlorination followed by dechlorination is an effective technique. This is a more complicated method that requires understanding and experience. Add 27 g or more of calcium hypochlorite crystals to a gallon (3.8 liters) of water to attain a chlorine concentration of 27 to 30 parts per million. After the requisite disinfection time (10 to 30 minutes), add six drops of concentrated (30%, caustic) hydrogen peroxide to dechlorinate the water. The chemical reaction produces calcium chloride (which remains in solution), water, and oxygen.
9. Chlorination can be combined with flocculation. AquaCure tablets contain alum and sodium dichloro-s-triazinetriene. Dropped into a liter of cloudy water, a tablet releases 8 mg/liter of free chlorine. If a tablet is dropped into clear water where the flocculation capability isn't exhausted, the alum causes a bit of cloudiness, and there is a stronger chlorine taste.
10. Aquamira water treatment uses stabilized 2% chlorine dioxide combined with an activator (5% food grade phosphoric acid) to improve the taste of water. One kit can be used to treat more than 120 liters of water. Mix 7 drops of the two bottles together, let sit for 5 minutes, and then pour the contents into 1 quart of water. Oxygen is released in a highly active form to kill odor-causing bacteria. The process takes approximately 20 minutes.
11. The SteriPEN carries the promotional byline of "safe drinking water anywhere." Distributed by Traveler's Supply, Inc., this unique hand-held water purifier that uses ultraviolet light (UVL) is advertised to fit into most plastic consumer water bottles, as well as other types of containers up to 32 ounces (1 liter). It operates on four AA batteries, with nickel-metal-hydride or lithium batteries recommended. According to the distributor, only 48 seconds of exposure to the UVL is required to disinfect 16 ounces ($\frac{1}{2}$ liter) of water and 90 seconds for 32 ounces (1 liter). The claim is

that the device is effective against common outdoor and household pathogens, as well as less common microorganisms, to include bacteria, viruses, and protozoa. The test results are found at an Internet link provided by the company. According to the product literature, the SteriPEN meets U.S. Environmental Protection Agency standards for microbiological water purifiers. A filter can be used to remove particulates from the water before UV treatment.

UWL works for water disinfection by destroying the DNA of microbes.

This keeps the germs from reproducing, which is necessary in order for them to make a person ill. The light emitted by the SteriPEN device is in the UV-C range, of wavelength 254 nanometers. This wavelength is germicidal (kills germs) by causing adjacent thymine base nucleotides in DNA to bond together, which prevents them from being properly recognized ("read") in the replication process, which is necessary for DNA to allow a microorganism to reproduce. Thus, the germ(s) is rendered harmless. Used as directed, the UWL exposure is of no consequence, as this wavelength of UWL does not pass through most materials (e.g., glass, metal, ceramic, and nearly all plastics). Furthermore, the underside of the air/water surface in a water container acts as a reflector for UV-C. So, if the SteriPEN lamp is completely immersed in water and used according to the instructions, the UV-C is contained and does not pose any health risk to the user. For additional safety, the SteriPEN is equipped with water sensors and will not operate unless the lamp is under water. The SteriPEN contains a microcomputer that controls operation time, according to information it receives from integrated temperature sensors and user indication of the volume of water to be disinfected. During use, the device should be used to gently stir the water. It is intended for use in clear water, so cloudy water must be filtered or otherwise made clear before using the SteriPEN. Disposable lithium or rechargeable AA nickel metal hydride batteries will provide many more disinfection cycles than will alkaline batteries. The latter are better in a cold weather situation.



MOTION SICKNESS

Motion sickness (seasickness, or “mal de mer”) is a common, annoying, and sometimes disabling problem for boaters and divers. Motion sickness is a complex phenomenon that involves the cerebellum (the part of the brain that controls, among other things, balance), vestibular system (labyrinth of the inner ear that plays a major role in the control of equilibrium), the nerve connections between the eyes and the inner ear, and the gastrointestinal tract. It is made worse by alcohol ingestion, emotional upset, noxious odors (e.g., boat exhaust fumes), and inner ear injury or infection. Most persons adapt to real motion after a few days, but may require treatment until they are adjusted to the environment.

Signs and symptoms of motion sickness include a sensation of dizziness or spinning, a sensation of falling, pale skin color, sweating, nausea, headache, drowsiness, weakness, yawning, and increased salivation. Vomiting may provide temporary relief, but prolonged salivation doesn’t occur until the inner ear labyrinth acclimatizes to motion or you are able to intervene with an anti-motion-sickness device or medication. Persons who suffer from prolonged vomiting become dehydrated and exhausted.

To manage motion sickness:

1. Keep your eyes fixed on a steady point in the distance. If on board a ship, stay on deck. Splash your face with cold water. If the seas are rough, be careful to not slip or fall overboard. If you can have someone next to you who is not suffering, that is better than leaning over the rail by yourself to vomit when you are dizzy.
2. Use the ReliefBand device. It is advertised to relieve nausea and vomiting with gentle, noninvasive electrical stimulation on the underside of the wrist. It can be used before or after symptoms begin; carries no restrictions on food, beverages, or the use of medications; and has no druglike side effects. The device looks like a wristwatch. The Adventurer model contains a battery-powered electrical stimulator that is easily adjustable for five different stimulation levels. The device is positioned over the P6 acupuncture site (the Neiguan, or Nei Kuan, point on the pericardial meridian). This is located 2 fingerbreadths toward the heart from the wrist joint between the two prominent finger flexor tendons. When the device is turned on, a pulse is generated every 4 seconds, and the user feels the episodic tingling sensation. It is theorized that the electrical signal transmitted via the median nerve in the wrist interrupts the nausea and vomiting messages that are transmitted between the brain and the stomach. The only side effect noted so far with the device is rare irritation where the electrodes make contact with the skin. This is easily managed by moving the device to the other wrist.
3. Some persons report that wearing a “sea band” is helpful. This is a knitted, elastic stretch band with a button(s) that applies pressure to an

acupuncture point(s). This would not be expected to be nearly as effective as the ReliefBand device, but might help out in a pinch.

4. Ingest meclizine (Antivert, Bonine) 25 mg, cyclizine (Marezine) 50 mg, or dimenhydrinate (Dramamine) 50 mg orally every 4 to 6 hours, or cinnarizine (Sturgeron) 15 mg every 8 hours as necessary to prevent and control motion sickness. These are adult doses. To be most effective, the first dose of medication should precede the environmental change by 1 hour. Medication given after the onset of seasickness will often be ineffective. Obviously, if you are vomiting so severely that you cannot keep any medication down, you may need to use a suppository, such as prochlorperazine (Compazine) 25 mg or promethazine (Phenergan) 25 mg, noting that these drugs won't cure the motion sickness—they might control vomiting, but have the side effect of drowsiness.
5. Place a transdermal scopolamine patch (Transderm-Scōp 1.5 mg) on the skin behind the ear. This patch releases the drug slowly through the skin and can be very effective against motion sickness for up to 3 days. Side effects include drowsiness, blurred vision (sometimes with a dilated pupil in the eye on the side of the patch), decreased sweating, difficulty with urination (particularly in elderly males with enlarged prostate glands), dry mouth, and a propensity to be susceptible to heat illness during times of heat exposure. Persons with glaucoma should not use the patch. On a rare occasion, a person who uses a patch can become delirious or even psychotic as a side effect. Normal behavior returns within a few hours after the patch is removed.

The patch should be positioned at least 3 hours before rough seas are encountered. If you touch the medicated (sticky) side of the patch with a finger and then let that finger come in contact with your eye, your pupil will almost certainly dilate and stay that way for up to 8 hours. *Be sure to wash your hands thoroughly with soap and water immediately after handling the patch, so that any drug that might get on your hands will not come in contact with your eyes.* Also, local absorption of the drug through the skin can dilate the pupil of the eye on the same side of the patch, causing difficulty with focusing of vision.

6. Reduce head movement. Do not consume alcoholic beverages, because these make you more prone to vertigo. If you are on a large boat that is rocking bow to stern, seek the middle (equilibrium) of the vessel, so that motion is minimized. Look out from the boat and find a broad view of the horizon. Don't do close-focused visual tasks such as reading, writing, and navigation. If you are becoming motion sick and can't control your symptoms, you might find some relief by lying faceup in a well-secured and ventilated bunk. Close your eyes and try to sleep.
7. Some people recommend "keeping something in your stomach" during a bout of motion sickness. You can put something in there, but if you are truly sick, it won't stay there for long. Try to maintain your fluid intake

with sips of something like an electrolyte-containing sports beverage (e.g., Gatorade or Gatorade G2). If you are known to suffer from motion sickness, take particular care to be well hydrated before your journey, because you will at a minimum have decreased appetite and fluid intake, and in the worst case, lose a fair bit of fluid by vomiting. While some persons recommend a light diet with predominantly carbohydrates, there is no evidence that any particular food or diet is beneficial. Ginger (*Zingiber officinale*) is sometimes recommended to curb nausea. It is taken as 1,000 mg (two 500 mg capsules) every 6 hours, supplemented by gingersnap cookies, ginger ale, and candied ginger.

Headache, ringing in the ears, weakness in an arm or leg, difficulty with speech, difficulty swallowing, decreased vision, and palpitations are not features of motion sickness and should raise suspicion for another cause of dizziness. If any of these occur, especially if the seas are not particularly rough and no one else is suffering, the victim should seek medical attention. Similarly, if the symptoms occur after a dive, one must consider the possibility of central nervous system decompression sickness (bends) or arterial gas embolism.

Finally, don't try to cure serious motion sickness by putting on your dive gear and heading underwater. Mild nausea attributable to seasickness may disappear when you get under the surface (and the objectionable motion ceases), but if you are ready to vomit, you shouldn't put yourself and your companions in a situation where you throw up underwater. It is not easy to vomit underwater and coordinate breathing through your regulator, and getting sick when you are in the water can lead to panic and a serious diving accident. Don't dive until you are feeling well.



FIRST-AID KITS

First-aid kits should be designed according to the environment to be encountered, number of travelers, medical training of the party leaders, and distance from sophisticated medical care. The following lists include items that could be included to deal effectively with the most common problems. They are not camping lists (shelter, food, toiletries, and the like). Basic survival supplies must be adequate. The more multipurpose your selections, the less the weight of your pack.

In all cases, what you should carry depends on your predetermined needs. As you review the sections of this book, you will be able to decide what to carry. For instance, a day hiker need not carry a portable traction splint, but a rock climber on a lengthy expedition should consider bringing one along. A scuba diver should carry a bottle of vinegar to pour on a jellyfish sting. Select the items that make sense for your group or expedition. Carry a realistic quantity of supplies; you should be prepared to treat more than one person at a time. Specific medications to choose from are described in Appendix 1 and throughout the book. Remember to bring along pediatric doses (in liquid form, if necessary) when traveling with children.

First-aid supplies should be packed to be readily accessible, and marked clearly to allow rapid identification. The supplies must be carried in a container(s) that can withstand physical abuse, extremes of temperature, and exposure to water. On boating, rafting, or diving adventures, carry medical supplies in a plastic (a Pelican Case, Storm Case, or Otter Box, for example) or metal container equipped with a rubber O-ring gasket for a tight, waterproof seal, or store the supplies in a “dry bag.” Use Ziploc-type bags within the kit for extra material and to sort your supplies. For instance, it is helpful to partition supplies into modules “for wound care,” “for an allergic reaction,” and so forth.

Carry a small notepad and waterproof writing instrument. A preprinted first-aid report form, designed for use on mountain or backcountry expeditions, is a convenient way to record a victim’s medical condition and treatment, while serving as a good checklist for proper evaluation. Space is usually provided for a written rescue request to be carried by a messenger in an emergency.

Before the trip, show all members of the expedition where the medical supplies are stored and explain how they are to be used.

An excellent selection of first-aid kits is available in stores and by mail order from Chinook Medical Gear, Inc. (www.chinookmed.com).

BASIC SUPPLIES

Brand names are shown to indicate representative products, not to indicate that these are the only products that may be used. Quality, availability, cost, and preference will influence which specific products you choose. Before you embark on an outdoor expedition, go through the relevant sections of this book and this list carefully, and make a decision to include or exclude these items from your medical kit.

GENERAL SUPPLIES

- Medical guidebook
- First-aid report form
- Pencil or pen with small notepad

- Steel sewing needle
- Paper clip
- Safety pins
- Needle-nose pliers with wire cutter
- Sharp folding knife
- Disposable scalpels (#11 and/or #12 blades)
- Paramedic or emergency medical technician (EMT) shears (scissors)
- Swiss Army knife or Leatherman-type tool
- Seam ripper
- Sharp-pointed surgical scissors
- Bandage scissors
- Splinter forceps (tweezers)
- Standard oral thermometer: digital, mercury, or alcohol
- Low-reading hypothermia thermometer
- Wooden tongue depressors (“tongue blades”)
- Rolled duct tape (3 in × 1 yd, or 91 cm)
- 1/8- to 1/4-inch-diameter braided nylon cord (minimum 10 ft, or 3 m)
- Water bottle (such as Nalgene 1/2 to 1 liter)
- Blue “baby bulb” or “turkey baster” suction device
- Waterproof flashlight (such as Pelican MityLite)
- Headlamp (and spare batteries)—preferably with floodlight and flash settings, able to withstand moisture and temperature extremes
- Cyalume fluorescent light sticks
- Cardiopulmonary resuscitation (CPR) mouth barrier or pocket mask (such as a Microshield X-L Mouth Barrier or NuMask CPRKIT)
- Sterile (hypoallergenic or latex) surgical gloves; if you are allergic to latex, bring other (such as nonlatex synthetic) nonpermeable gloves
- Signal mirror
- Magnifier
- Waterproof matches
- Fine-mesh head net or travel tent to repel insects
- Oral rehydration salts or Cera Lyte 70 oral electrolyte powder
- Rubber cement
- Urine pregnancy test

WOUND CARE—PREPARATIONS AND DRESSINGS

- Elastic bandages (Band-Aid or Coverlet), assorted sizes (strip, knuckle, and broad); cloth with adhesive is preferable
- Band-Aid Liquid Bandage
- Butterfly bandages
- Adhesive strips for wound closure (Steri-Strip or Cover-Strip II), assorted sizes (such as 1/4 in × 4 in, 1/8 in × 3 in, 1/2 in × 4 in), reinforced (plain or impregnated with an antimicrobial) or elastic

- 3 in × 3 in or 4 in × 4 in sterile gauze pads (packets of 2 to 5) (such as Nu-Gauze highly absorbent)
- 5 in × 9 in or 8 in × 10 in sterile gauze (“trauma”) pads (packets of 2 to 5)
- Nonstick sterile bandages (Telfa), assorted sizes
- 1 in, 2 in, 3 in, and 4 in rolled conforming gauze (C-wrap or Elastomull)
- 1 in × 10 yd (9.1 m) rolled cloth adhesive tape
- 1 in × 10 yd (9.1 m) rolled paper or silk (hypoallergenic) adhesive tape
- 1 in × 10 yd (9.1 m) rolled waterproof adhesive tape
- ½ in × 10 yd (9.1 m) rolled waterproof adhesive tape
- Blist-O-Ban blister bandages (assorted sizes)
- Molefoam (4⅞ in × 3⅜ in)
- Moleskin Plus (4⅞ in × 3⅜ in)
- Spenco 2nd Skin (1.5 in × 2 in, 3 in × 4 in, 3 in × 6.5 in) and Spenco Adhesive Knit Bandage (3 in × 5 in)
- Aquaphor moist nonadherent (petrolatum-impregnated) dressing (3 in × 3 in)
- Hydrogel occlusive absorbent dressing (4 in × 4 in × ¼ in)
- Tegaderm transparent wound dressing (also comes in combination with a Steri-Strip in a Wound Closure System)
- Liquid soap
- Sterile disposable surgical scrub brush
- Cotton-tipped swabs or applicators, sterile, 2 per package
- Safety razor
- Syringe (10 mL to 60 mL) and 18-gauge intravenous catheter (plastic portion), for wound irrigation (do *not* use plastic disposable syringes to administer oral medications, as the small caps can dislodge and inadvertently eject into the patient’s throat)
- Zerowet Splashield (2)
- Tincture of benzoin, bottle or swabsticks
- Benzalkonium chloride 1:750 solution (Zephiran)
- Povidone iodine 10% solution (Betadine), 1 oz bottle or swabsticks
- Suture material (nonabsorbable monofilament nylon on curved needle, suture sizes 3/0 and 4/0; consider sizes 2/0 (thicker) and 5/0 (finer))
- Stainless-steel needle driver
- Disposable skin stapler (15 staples)
- Disposable staple remover
- Tissue glue

SPLINTING AND SLING MATERIAL

- Cravat cloth (triangular bandage)
- 2 in, 3 in, and 4 in elastic wrap (Ace)
- 4¼ in × 36 in SAM Splints (2)
- Aluminum finger splints
- Kendrick femur traction device

EYE MEDICATIONS AND DRESSINGS

- Prepackaged individual sterile oval eye pads
- Prepackaged eye bandages (Coverlet Eye Occluser)
- Metal or plastic eye shield
- Sterile eyewash, 1 oz (30 mL)
- Contact lens remover (or mini-marshmallows)
- Ofloxacin, moxifloxacin, or gatifloxacin eyedrops
- Oxymetazoline hydrochloride 0.025% eyedrops

DENTAL SUPPLIES

- Oil of cloves (eugenol), 3.5 mL
- Cavit, 7 g tube
- IRM (Intermediate Restorative Material)
- Express Putty
- Zinc oxide powder
- Dental floss
- Mouth mirror
- Paraffin (dental wax) stick
- Wooden spatulas
- Cotton (rolls and pellets)

TOPICAL SKIN PREPARATIONS

- Hydrocortisone cream, ointment, or lotion (0.5% to 1%)
- Potent corticosteroid ointment
- Bacitracin ointment
- Mupirocin ointment
- Mupirocin calcium 2% cream
- Bacitracin-neomycin polymyxin B sulphate ointment
- Miconazole nitrate 2% antifungal cream
- Silver sulfadiazine 1% (Silvadene) cream
- Insect repellent
- Sunscreen lotion or cream
- Lip balm or sunscreen
- Sunblock
- Adolph's meat tenderizer (unseasoned)
- Kenalog in Orabase (oral adhesive steroid for canker [mouth] sores), 5 g container
- Aloe vera gel
- Hemorrhoidal ointment with pramoxine 1%

NONPRESCRIPTION MEDICATIONS

- Buffered aspirin, 325 mg tablets
- Ibuprofen, 200 mg tablets
- Acetaminophen, 325 mg tablets
- Antacid
- Decongestant (such as pseudoephedrine) tablets
- Decongestant (such as oxymetazoline) nasal spray
- Loperamide (Imodium A-D), 2 mg caplets
- Glucose (liquid glucose) paste tube
- Stool softener (such as docusate calcium, 240 mg gel caps)
- Caffeine, 200 mg tablets (to stay awake for survival purposes, such as during a rescue)

PRESCRIPTION MEDICATIONS (SELECT FROM THIS LIST, AND FROM INFORMATION THROUGHOUT THIS BOOK, WHAT YOU FEEL YOU MIGHT NEED; THE DRUGS LISTED ARE FOR EXAMPLE)

- Pain medication(s): e.g., hydrocodone 5 mg with acetaminophen 500 mg
- Asthma medication(s); e.g., metered-dose bronchodilator (albuterol)
- Allergy medication(s): e.g., epinephrine (injectable) and prednisone, 10 mg tablets
- Antibiotics: e.g.,
 - penicillin V potassium, 250 mg tablets
 - azithromycin, 250 mg tablets
 - dicloxacillin, 250 mg tablets
 - ampicillin, 250 mg tablets
 - amoxicillin-clavulanate, 500 mg tablets
 - erythromycin, 250 mg tablets
 - cephalexin, 250 mg tablets
 - ciprofloxacin, 500 mg tablets
 - tetracycline, 500 mg tablets; or doxycycline, 100 mg tablets
 - trimethoprim-sulfamethoxazole, double-strength tablets
- Anti-nausea medication(s): e.g.,
 - prochlorperazine (Compazine) suppositories, 25 mg
 - promethazine (Phenergan) suppositories, 25 mg

ALLERGY KIT

- Allergy kit with injectable epinephrine (EpiPen autoinjector [0.3 mg] and EpiPen Jr. autoinjector [0.15 mg]; or Twinject 0.3 or 0.15 mg autoinjector)
- Diphenhydramine, 25 mg capsules

FOREST AND MOUNTAIN ENVIRONMENTS

- Water disinfection equipment or chemicals (such as Potable Aqua tablets or Polar Pure iodine crystals)
- Calamine lotion
- SPACE Emergency Blanket (2 oz, 56 in × 84 in) (alternatives include Pro-Tech Extreme bag or vest, SPACE brand emergency bag, SPACE brand all-weather blanket)
- Hypothermia thermometer
- Hyperthermia thermometer
- Whistle
- Acetazolamide (Diamox), 250 mg tablets
- Dexamethasone (Decadron), 4 mg tablets
- Nifedipine (Adalat CC), extended-release 30 preparation
- Powdered electrolyte beverage mix (Oral Rehydration Salts)
- Instant chemical cold pack(s)
- Hand warmer (mechanical or chemical)
- Kendrick Traction Device (leg splint)

AQUATIC ENVIRONMENTS

- Waterproof dry bag or hard case (such as Pelican or Storm), to carry first-aid supplies
- Motion-sickness medicine
- Acetic acid (vinegar) 5%
- Isopropyl alcohol 40%
- Hydrogen peroxide
- VoSol otic solution
- Ofloxacin 0.3% ear drops
- Safe Sea Sunblock with Jellyfish Sting Protective Lotion



IMMUNIZATIONS

Because the spectrum of infectious diseases changes with time and location, travelers to or between foreign countries should be aware of the necessity for immunizations. The Centers for Disease Control and Prevention (CDC) has a comprehensive traveler's health website at wwwn.cdc.gov/travel/default.aspx.

A detailed, updated list of required immunizations by country can be obtained in the publication *Health Information for International Travel* (CDC), also known as the "Yellow Book." The CDC Internet site, with links to the online copy of the Yellow Book and instructions for ordering a hard copy, is wwwn.cdc.gov/travel/contentYellowBook.aspx.

Vaccinations may be given under the supervision of any licensed physician. All travelers should carry a completed International Certificate of Vaccination with proper signature and validation for all vaccinations administered. Yellow fever and cholera vaccinations must be officially recorded and stamped. Failure to secure validation at an authorized city, county, or state health department renders the certificate invalid, and may force you to be revaccinated or quarantined.

It is extremely important to plan immunizations as far in advance of an expedition as possible, since some vaccines interact in ways that diminish effectiveness. For instance, yellow fever and cholera vaccines need to be given either on the same day or at least 3 weeks apart.

TETANUS

Everyone should be properly immunized against tetanus, which is caused by the bacterium *Clostridium tetani*. In the United States, diphtheria-tetanus-pertussis (DTAP) vaccine is given as an intramuscular injection at ages 2, 4, 6, and 8 months, followed by a booster at age 4 to 6 years, usually before entry into school. These shots provide immunity from tetanus, as well as from diphtheria and pertussis (whooping cough), for about 10 years. The first booster shot is usually given at age 11 or 12 years in the form of Tdap vaccine. Thereafter, Td (tetanus and diphtheria) vaccine is recommended at 10-year intervals. However, given a resurgence of whooping cough seen in adults, the recommendation may change to continue immunizing against pertussis with the Tdap vaccine in perpetuity. Following immunization against tetanus, immunity in any individual is unknown, and can be determined by measuring antibodies in blood. This is particularly important in elders, in whom the immune response to vaccination may be suppressed by a general lower level of the immune system associated with age.

Here are the vaccines that are licensed as of this writing for different age-groups:

1. Tdap (tetanus, diphtheria, pertussis): Adacel (Sanofi Pasteur) ages 11 to 64 years; Boostrix (GlaxoSmithKline) ages 10 to 18 years
2. DTaP (diphtheria, tetanus, pertussis): Daptacel (Sanofi Pasteur) ages 6 weeks to 7 years; Tripedia (Sanofi Pasteur) ages 6 weeks to 7 years; Infanrix (GlaxoSmithKline) ages 6 weeks to 7 years; Pediarix (GlaxoSmithKline) ages 6 weeks to 7 years
3. Td (tetanus, diphtheria): Td (Sanofi Pasteur) ages 7 years and older

One obvious question is, “Which vaccine should be used for children between ages 7 years and 10 years?” It is probably best to use the DTaP vaccine for this age-group, even though no vaccine is licensed for this age-group, and either Tdap or DTaP would likely induce the proper immunities.

The current practice is to take a booster shot (Td) if one sustains a “dirty” wound, deep puncture, serious burn, significant crush injury, or similar injury and has not had a tetanus shot in the preceding 5 years. If a wound is believed to be at particularly high risk for infection with *C. tetani* (e.g., if it is a very deep puncture or contaminated by soil or animal feces), it may also be recommended to have an injection of tetanus immune globulin, as well as a tetanus booster immunization. Whether or not to administer tetanus immune globulin is generally a judgment call by the treating health care professional. The immune globulin contains actual antibodies against the bacteria, so that the recipient carries protective antibodies against the bacteria until his or her body has a chance to manufacture its own antibodies in response to the Td booster shot.

Any traveler who will be away from medical care for more than 48 hours should have adequate tetanus immunization. The recommendations are as follows:

1. A person previously immunized should receive a booster dose of tetanus toxoid if his last dose was not administered within the past 10 years. A dose of Tdap vaccine (tetanus, diphtheria, and pertussis) may be administered if pertussis is a concern. Diphtheria immunization is usually boosted simultaneously. If there is a good chance that the traveler will suffer an injury during the trip, he should take a booster if the last dose was not administered within the past 5 years.
2. Nonimmunized individuals should become immunized with a series of three injections (this requires 3 to 6 months).

Low-risk (for tetanus infection) wounds are those that are recent (less than 6 hours old), simple (linear), superficial (less than $\frac{1}{2}$ in, or 1.3 cm, deep), cut with a sharp edge (knife or glass), without signs of infection, and free of contamination with dirt, soil, or body secretions. High-risk wounds are those that are old (greater than 6 hours), crushed or gouged, deep (greater than $\frac{1}{2}$ in deep), burns,

frostbite, with signs of infection, and contaminated. If someone suffers a wound, here are standard recommendations:

Victim	Low-Risk Wound (not heavily contaminated)	Contaminated Wound (tetanus-prone)
Never Immunized	<i>Tetanus toxoid</i> <i>Tetanus immune globulin</i>	<i>Tetanus toxoid</i> <i>Tetanus immune globulin</i>
Immunized		
Last booster within 5 yr	<i>No shot</i>	<i>No shot</i>
Last booster within 10 yr	<i>No shot</i>	<i>Tetanus toxoid</i> <i>Tetanus immune globulin</i>
Last booster over 10 yr	<i>Tetanus toxoid</i>	<i>Tetanus toxoid</i> <i>Tetanus immune globulin</i>

**POLIOVIRUS; DIPHTHERIA; PERTUSSIS (WHOOPING COUGH);
MEASLES, MUMPS, RUBELLA (GERMAN MEASLES);
CHICKENPOX; HAEMOPHILUS B; ROTAVIRUS**

Immunization against poliomyelitis, diphtheria, pertussis, measles, mumps, and rubella should be obtained before travel. These are routinely administered during childhood in the United States. Because of the incidence of these infectious diseases in developing countries, such immunizations are mandatory before travel. Immunizations against *Haemophilus* type b (which causes middle ear infections and meningitis) and the virus that causes chickenpox are available, and should be considered under recommendation from your physician. Measles vaccine should be given to any person born after 1956 who has not received a prior booster dose. Mumps (a viral infection) is making a comeback in the United States and other countries because of failure to vaccinate. It is not a trivial disease, particularly in adults, and is highly communicable. In children, mumps typically causes fever, headache, muscle aching, fatigue, loss of appetite, and swelling of salivary glands, in particular the parotid glands, which are located in the cheeks directly in front of the ears. In adults, complications of mumps may include inflammation of brain, meningitis, swollen and painful inflamed testicles, ovarian or breast inflammation, miscarriage, and deafness.

Polio is still present in developing nations (e.g., sub-Saharan Africa, India, Nepal, Indonesia, Pakistan). Unimmunized adults (age greater than 18 years) should receive a series of three injections of the inactivated (virus) Salk vaccine, not the oral (Sabin) vaccine, which is recommended for children. Those under 18 who have never been immunized should receive three doses of oral polio vaccine 1 month apart. People who travel to high-risk

areas (e.g., outside the Western Hemisphere) who were immunized as children should receive one booster dose of oral polio vaccine or an injection of e-IPV polio vaccine.

Two adolescent/adult formulations of pertussis vaccine are combined with diphtheria and tetanus toxoids (Tdap): Boostrix (approved for ages 10 to 18 years) and Adacel (approved for ages 11 to 64 years). One of these should be given instead of standard tetanus-diphtheria vaccine if pertussis is a concern.

RotaTeq is an oral vaccine given in a three-dose series recommended for infants to prevent the gastrointestinal illness caused by rotavirus. Rotarix is given in two doses. It is advised that children who have had an episode of intussusception not receive these vaccines.

SMALLPOX

The last reported case of endemic smallpox (caused by the *Variola* virus) was in Somalia in 1977. Therefore, smallpox immunization is no longer required for international travel, and the vaccine is not commercially available. However, there is a chance that isolated cases still occur (without reporting) in India, the Himalayas, and equatorial Africa. Travelers to these areas should inquire about the latest recommendations from the CDC in Atlanta.

Because smallpox has been suggested as an agent of bioterrorism, a brief description of infection for the purpose of recognition follows. The virus enters a human through the respiratory tract. It incubates and multiplies for 7 to 17 days, after which the victim abruptly develops severe headache, backache, and fever. The mouth, tongue, and throat may show lesions before the onset of the rash on the skin, which begins as small red spots and bumps that become blisters over a few days. Usually, the rash appears first on the face and limbs, and then appears on the torso. The blisters may appear pus-filled with depressed centers and take a week to dry and form a crust. As opposed to chickenpox, where the skin lesions are in various stages of development, all the lesions of smallpox are in the same stage of development. With chickenpox, the fever accompanies the onset of the rash, and the rash is more concentrated on the torso, rather than the limbs.

Smallpox vaccine can be effective if administered before exposure or early enough in the incubation period.

Monkeypox, which along with smallpox is an “orthopox,” is endemic to forested areas of western and central Africa, but does not as yet pose a significant public health risk; there is no vaccine against the causative agent. It has been reported to be present in southern Sudan.

CHOLERA

Cholera is an intestinal infection caused by 2 serogroups (01 and 0139) of the microorganism *Vibrio cholerae*, either of which induces painful diarrhea and extreme fluid losses through the gastrointestinal tract. Cholera can reach epidemic

proportions. It is estimated that 4 out of every 100 persons who acquire the illness die. A person whose stomach contains normal gastric acid is not at much risk for acquiring cholera. No country currently requires immunization, and the CDC does not recommend cholera vaccination for travel. However, some localities require proof of cholera immunization for travelers entering from a territory that still reports the disease. For this purpose, documentation of a single dose of oral vaccine (not available in the United States) generally is sufficient. The only vaccine available is a killed whole-cell vaccine. It is likely that as vaccines become less expensive, they will be used more often in areas where the infection is endemic.

YELLOW FEVER

Yellow fever is acquired in tropical (sub-Saharan) Africa and tropical South America, where victims may suffer the bite of the *Aedes aegypti* mosquito (urban environment) or other mosquitoes (jungle environment). Immunization is effective in preventing the disease; a single 0.5 mL subcutaneous injection of 17-D-204 strain YF-VAX (Aventis) is administered and immunity is acquired after a 10-day waiting period. The vaccine is good for 10 years, after which time a booster is required to maintain immunity. Infants younger than 9 months and pregnant women should not be routinely immunized, unless they are at high risk for contracting the disease. It is also contraindicated in people with immunosuppression (such as human immunodeficiency virus [HIV] infection) or with an allergy to eggs. Yellow fever vaccinations must be given at an officially designated Yellow Fever Vaccination Center, and the certificate validated at the same center. The vaccine is not required for travel from the United States into Canada, Mexico, Europe, or Caribbean countries, but should be considered for travel into the province of Darien in Panama. The CDC travel Internet site should be consulted for the latest information on recommendations. To be maximally effective, cholera and yellow fever vaccines should be administered either at the same time or at least 3 weeks apart. A rare side effect of yellow fever vaccination is a severe reaction with symptoms similar to those of yellow fever. This may occur in 1 in 50,000 elderly (greater than 65 years old) recipients. An exemption (from vaccination) letter from a doctor acceptable to the customs officials of a destination country may allow a person to skip the immunization requirement.

MENINGOCOCCUS

The meningococcus is a bacterium (*Neisseria meningitidis*) that can cause meningitis, particularly in children and young adults. It is a wise idea for travelers to Nepal—particularly hikers and backpackers—to be immunized. Certain areas of sub-Saharan Africa are also considered high risk from December to June. Vaccination against meningococcal disease is not a requirement for travel to any country except Saudi Arabia, where travelers to Mecca during the annual Hajj

and Umrah pilgrimage must have proof of vaccination. Menactra, a tetravalent meningococcal polysaccharide-protein conjugate vaccine (MCV₄), provides protection against serogroups A, C, Y, and W-135 of the bacteria, and is given in one subcutaneous injection; protection for 5 years is achieved 1 to 2 weeks after administration. It is approved for persons ages 2 to 55 years. The vaccine is now recommended for children aged 11 to 12 years in the United States at their regular health care visit, and if at all possible before entry into college. The vaccine previously recommended by the CDC is Menomune, a tetravalent meningococcal polysaccharide vaccine (MPSV₄) that is still available and is believed to be somewhat less effective. It is recommended for persons older than 55 years, or at any age if MCV₄ is not available. The vaccines are believed to provide immunity for 5 years when administered at age 4 years or older. If someone has not been immunized and comes in close contact with a person known to have meningococcal disease, antibiotics can be prescribed within 14 days of exposure for 3 days to prevent or minimize the spread of the disease. The recommended antibiotics are rifampin for children and adults, ciprofloxacin for adults, or ceftriaxone (injection) for children and adults. Azithromycin in a single 500 mg dose is also likely effective.

HERPES ZOSTER

Zostavax is a new vaccine to reduce the risk for herpes zoster in adults ages 60 years and older. It is given in a dose of 0.65 mL one time subcutaneously. Because it contains live attenuated virus, it should not be given to anyone who is immunosuppressed for any reason. It is given as a single dose subcutaneously. It appears to be quite effective in preventing shingles in persons who have never before suffered from this condition.

HUMAN PAPILLOMAVIRUS

A vaccine (Gardasil [quadrivalent human papillomavirus types 5, 11, 15, 18 recombinant]) is approved to prevent infection with human papillomavirus in females ages 10 to 26 years. The vaccine is administered in three doses at 0, 2, and 6 months, intended to prevent infection that might lead to later development of cervical cancer.

HEPATITIS

A recombinant DNA vaccine (Recombivax, not derived from human plasma) for immunization against viral hepatitis type B is recommended for travelers to underdeveloped countries. A series of three injections requires 6 months to complete. Another recombinant vaccine is Engerix-B, which can be given on an

accelerated schedule over 2 months. If a person has not been immunized against hepatitis type B and is exposed to the virus (e.g., by a needle stick), he may require an injection of hepatitis B immune globulin to provide short-term protection until immunity can be acquired from the DNA vaccine.

Hepatitis A virus is spread through contamination of water and food, and is often encountered in developing nations and areas of poor hygiene. Hepatitis A vaccine (Vaqta), inactivated, is available. It is administered intramuscularly to those age 2 years or older at least 2 weeks before exposure to hepatitis A virus. The dose is 0.5 mL (25 units) up to age of 18 years, and 1 mL (50 units) in people older than 18 years. It is given in a series of two injections. Havrix is a similar vaccine. Twinrix is a combination vaccine (hepatitis A and B) given to persons age 18 years and older in a 1.0 mL dose in a three-injection series at 0, 1, and 6 months. In an alternative dosing regimen, it can be given at day 0, day 7, a day chosen between days 21 to 28, and at 1 year (booster).

Pooled immune serum globulin (ISG, or gamma globulin) can be administered to prevent or diminish the effects of viral hepatitis type A in unimmunized people. The administration of ISG interferes with the antibody response stimulated by other live-virus vaccines, so it should be administered 2 to 4 weeks after any other vaccines. Because the effects of ISG disappear after 6 months, it should be administered just before the trip, and at appropriate booster intervals during prolonged travel in endemic areas. It should be administered in the event that someone has been given his or her first dose of hepatitis A vaccine, but a period of less than 2 weeks has elapsed after injection and before risky travel.

BUBONIC PLAGUE

A preexposure vaccine is available for immunization against bubonic plague caused by *Yersinia pestis*. This is administered only to people whose travels or occupations place them at high risk. In most countries where plague is reported, the risk is greatest in rural mountain or upland regions. Vaccination is generally considered for those who will reside in regions where plague is endemic, and where avoidance of rodents and fleas is impossible. The vaccine is injected in two doses 1 month apart, followed by a booster dose after 6 months.

RABIES

Preexposure and postexposure rabies vaccinations are discussed on page 410.

MALARIA

Malaria is discussed on page 146.

TYPHOID FEVER

Typhim Vi polysaccharide vaccine is available for immunization against typhoid fever caused by *Salmonella typhi*. Immunization is recommended for travelers who visit countries (e.g., Cambodia, Nepal, South Africa, Indonesia, and many others) known to harbor the disease, and for persons with adventurous dietary habits. A single intramuscular injection is required, followed by booster injection at 2-year intervals, depending on the local disease risk. An oral vaccine (Vivotif Typhoid Vaccine Live Oral Ty21a, Berna Products) is given as one capsule every other day for four doses in people age 6 years or older. A booster series is necessary every 5 years. The oral vaccine regimen should be completed at least 7 days before travel. Capsules, which should be kept refrigerated, should be swallowed (not chewed) with cool or lukewarm water on an empty stomach and without concomitant alcohol within 2 hours of ingestion. Side effects, which include fever, headache, and flu-like symptoms, are more commonly associated with the injections. Gastroenteric symptoms may be associated with the oral vaccine.

TYPHUS FEVER

Typhus vaccine is no longer available in the United States, and, is not recommended for the foreign traveler.

INFLUENZA

Influenza vaccine is administered in one or two injections to children and adults in October and November (in the Northern Hemisphere) before the flu season (December through March), with a maximum duration of effect of 6 months. It is approved for use in persons ages 6 months and older. Persons 3 years of age or older should receive a single intramuscular injection of 0.5 mL. Children 6 to 35 months of age should receive only 0.25 mL. Children younger than 9 years of age who have never been immunized should receive two doses spaced at least 4 weeks apart.

Vaccination of high-risk people (older than 65 years or with chronic illness) before flu season is essential. Persons for whom annual vaccination is recommended include the following:

- All persons who wish to reduce the risk of becoming ill with influenza or transmitting the disease to others
- Children ages 6 months to 4 years
- All persons ages 50 years or greater
- Children and adolescents ages 6 month to 18 years receiving long-term aspirin therapy who might be at risk for experiencing Reye syndrome
- Women who will be pregnant during influenza season
- Adults and children who have immunosuppression caused by medications or HIV

- Adults and children who have chronic pulmonary (including asthma), cardiovascular (except hypertension), kidney, liver, blood, or metabolic (including diabetes) disorders
- Adults and children with any condition that might compromise respiratory function
- Health care personnel

Each year, the vaccine contains the influenza virus strains that are believed to be most prevalent in the United States. Inactivated (killed-virus) influenza vaccine should not be given to those who are sensitive to egg products. “Whole” vaccines should not be given to children under age 13 years. Children should be given “split” vaccines, which have been chemically treated to reduce adverse reactions.

A live, attenuated nasal spray vaccine (FluMist) is at least as effective as injected vaccine, and is approved for persons ages 5 to 49 years who are free of chronic illnesses. It is administered as a spray of 0.25 mL into each nostril (0.5 mL total dose). Children ages 5 to 8 years old who have not been previously immunized should receive two doses spaced at least 6 weeks apart. FluMist should not be administered to family members or close contacts of immunosuppressed persons requiring a protected environment.

Amantadine hydrochloride (Symmetrel) and rimantadine are prescription oral drugs that interfere with viral uncoating within living cells and are moderately effective in preventing influenza A. However, because they confer no protection against influenza B, they are not considered substitutes for appropriate immunization.

Oseltamivir phosphate (Tamiflu) is an antifu pill given in a dose of 75 mg twice a day for adults. Zanamivir (Relenza) is a similar drug administered in a dose of 2 inhalations twice daily. These drugs interfere with the release of newly formed influenza virus from host cells and can be used to both prevent and treat influenza A and B.

PNEUMOCOCCAL PNEUMONIA

A polyvalent pneumococcal polysaccharide vaccine is available against pneumonia caused by *Streptococcus pneumoniae* (pneumococcus). In general, this vaccine is recommended for elderly (over 65 years) or infirm (those with cancer or with chronic heart, kidney, liver, or lung disease; people without a spleen; alcoholics; diabetics; those with sickle cell anemia) travelers who would be debilitated by a bout of pneumonia. The vaccine is not routinely recommended for children.

JAPANESE ENCEPHALITIS

Japanese encephalitis is a viral disease transmitted predominantly by *Culex* mosquitoes in South Asia, Southeast Asia, and the Asian Pacific Rim. Wind-blown mosquitoes have perhaps spread the virus from Papua New Guinea to the Australian mainland. The victim first suffers a mild, nonspecific viral illness

accompanied by fever and headache. Most infections remain mild. However, in an extremely small number of cases, the victim goes on to develop severe meningoencephalitis, characterized by headache, weakness, fatigue, fever, confusion, seizures, paralysis, and altered mental status. There is no specific therapy beyond supportive care. From 20% to 30% of victims die.

Travelers for more than 1 month to tropical Asia, particularly into rural rice-growing settings, are candidates for Japanese B encephalitis vaccine, which is given in a series of three injections over 2 weeks to 1 month. A booster dose may be given after 2 to 3 years. The current vaccine may cause side effects that may not occur until a week after the final injection, so it is recommended that travel not occur until at least that time has elapsed. Newer inactivated and live attenuated vaccines are becoming available.

LYME DISEASE

See page 157.

PHYSICIANS ABROAD

A traveler to a foreign country may become ill enough to require the services of a physician. The International Association for Medical Assistance to Travellers (IAMAT) is a nonprofit organization that provides a list of approved doctors who adhere to international standards, which include standard fees. IAMAT also distributes, free of charge, updated material on immunization requirements, malaria and other tropical diseases, and sanitary (food and water) and climatic conditions around the world. The directory of affiliated institutions can be obtained by calling or writing to IAMAT in Ontario, Canada. Other international medical assistance and rescue programs include the following (since specific street addresses and phone numbers are constantly changing, check with directory assistance):

- Air Ambulance Network, Inc., Tarpon Springs, Florida
- Divers Alert Network, Duke University Medical Center, Durham, North Carolina
- Global Emergency Medical Service, Alpharetta, Georgia
- Global Rescue, Boston, Massachusetts
- International SOS Assistance, Philadelphia, Pennsylvania
- Medex Assistance Corporation, Baltimore, Maryland
- Travel Assistance International, Millersville, Maryland



TRANSPORT OF THE INJURED VICTIM

1. Never move a victim unless you know where you are going. If you are lost and caring for an injured victim (or yourself), prepare a shelter. Try to position yourself so that visual distress signals can be fashioned in an open field, in the snow, or near a visible riverbank. Keep the victim covered and warm. Assume that the victim is frightened and needs frequent reassurance. If he cannot walk, you must attend to his bodily functions. A urinal can be constructed from a wide-mouthed water bottle. Defecation is more complicated, but may be assisted by cutting a hole in a blanket or sleeping pad placed over a small pit dug in the ground.
2. Unless you are in danger, never leave a victim who is unconscious or confused.
3. If possible, send someone for help and wait with the victim, rather than perform an exhausting and time-consuming solo or duo extrication. If someone is to be sent for help, choose a strong traveler and provide him with a written request that details your situation (number of victims, injuries, need for supplies, specific evacuation method required). While you certainly don't want to underestimate the seriousness of the situation, don't request a helicopter evacuation for someone with a sprained ankle who can easily be carried out in a litter. Anyone sent to obtain assistance should contact the closest law enforcement agency, which will seek the appropriate rescue agency.
4. Conserve your strength. Don't create additional victims with heroic attempts at communication or feats of strength and exertion.
5. Attempt to transport a victim only if waiting for a rescue party will be of greater risk than immediate movement, if there are sufficient helpers to carry the victim (as a general rule, it takes six to eight adults to carry one injured victim), and if the distance is reasonable (under 5 miles, or 8 km). A victim who is carried on an improvised stretcher over difficult terrain usually gets a rough ride. Always test your carrying system on a noninjured person before you use it on the victim.

LIFTING AND MOVING TECHNIQUES

Straight Lift

If a person is seriously injured, profoundly weak, or unconscious, he should be lifted so that he remains motionless and with his spine in as straight an alignment as possible. This can be accomplished by five rescuers. The first kneels at the head, controls the victim's head and neck, and calls out commands. The other four rescuers kneel at the victim's sides, one at chest level and one at hip level on one side, and the others at lower back level and leg level on the opposite

side (Figure 232). In this way, they can slide their hands under the victim in a staggered fashion to provide a continuous chain of support. If necessary, the rescuer closest to the legs can free a hand to position a pad, backboard, or litter underneath the victim. The rescuers should lift the victim straight up into the air, taking care not to injure *their* backs.

Logrolling the Victim (See Figure 25)

The best way to carry and immobilize a person who may have an injured spine is to use a scoop stretcher, or to slide a backboard underneath the victim. However, when these are not available and a spine-injured person must be turned, logrolling is the best alternative. It is also the preferred method to turn a victim on his side in order to slide a pad, board, or litter underneath him.

1. The first rescuer approaches the victim from the head, and keeps the head and shoulders in a fixed position (no neck movement).
2. The second rescuer extends the victim's arm (on the side over which the victim is to be rolled) above the victim's head. The first rescuer takes this arm and uses it to help support the head in proper position. If the arm is injured, it is maintained at the victim's side.
3. All rescuers work together to roll the victim, without moving his neck.

CARRIES AND LITTERS

The method of evacuation used to transport a victim will depend on the degree of disablement and what is available to the rescuer(s). To conserve the energy of all party members, victims of minor injuries should travel under their own power as much as possible, but should never travel unattended. One healthy and strong person should accompany anyone who must leave the group for medical reasons.

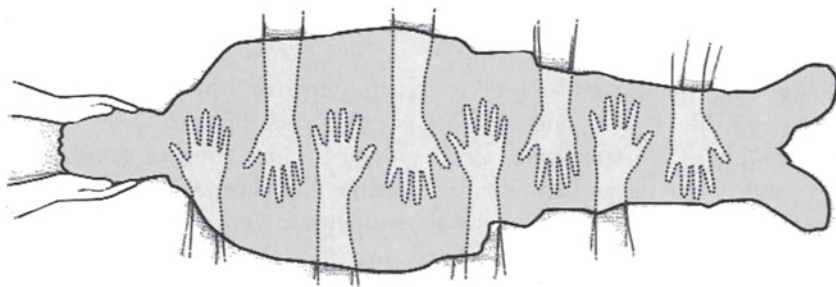


Figure 232. Proper hand positioning for straight lift.

Carries

If the victim has suffered an injury that does not allow him to walk out, mechanical transport must be improvised. A single person who cannot walk but who does not need to be on a litter (one with, for example, a broken ankle, mild exhaustion, or acute mountain sickness) may be carried on the back of a strong rescuer using a rope seat. This is fashioned by passing a long 1 in (2.5 cm) rope or strap across the victim's back and under his arms, then crossing the rope in front of his chest. The victim is loaded piggyback onto the rescuer's back, and the rope ends are passed forward over the shoulders of the rescuer, under his arms, and around to the rescuer's back, then between and through the victim's legs from the front, and around the outside of the victim's legs just under the buttocks, to be tied snugly in front of the rescuer's waist (Figure 233). Such a rope seat is far preferable to a standard fireman's carry, which is very fatiguing (Figure 234). A blanket drag (Figure 235) is only good for very short distances, such as to pull a person quickly away from an immediate hazard.

Other simple ways to carry a victim include the four-hand seat, backpack carry, ski pole or tree limb backpack carry, and coiled rope seat. In the first method, two rescuers interlock hands. Each rescuer first grasps his right wrist with his left hand. Holding the palms down, each rescuer then firmly grasps the left wrist or forearm of the other rescuer with his right hand, interlocking all four hands (Figure 236). The victim sits on the four-hand seat. In the second method, leg holes can be cut into a large backpack, so that a victim can sit in it like a small child would in a baby carrier. In the third method, two rescuers with sturdy backpacks stand side by side. Pack straps are looped down from each pack, and ski poles or tree limbs are slung across through the loops, or the poles are placed to rest on the padded hip belts. The poles should be padded so that the victim can sit on the rigid seat, steadying himself by draping his arms around the



Figure 233. Fashioning a rope (webbing) seat.

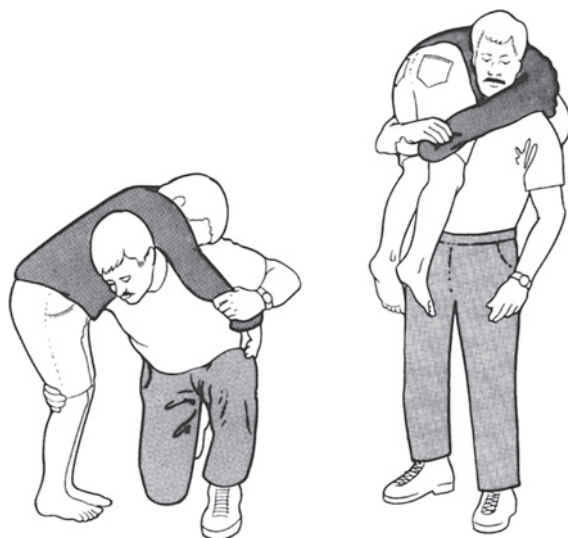


Figure 234. Fireman's carry.

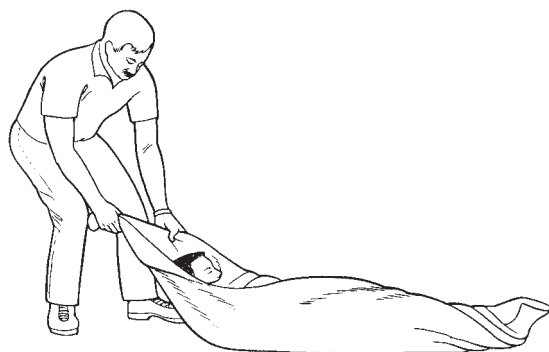


Figure 235. Blanket drag.

shoulders of his rescuers (Figure 237). The split-coil rope seat is created by coiling a rope, then fixing the coil at one segment. The coil's loops are split and used to position the victim on the rescuer's back (Figure 238). A two-rescuer split-coil technique is also useful (Figure 239).

Litters

The safest anatomical position for an injured victim (from a transport perspective) is supine with his back straight, eyes forward, and arms and legs straight with his hands at his sides. If the victim might vomit or is unconscious, he should be on his side, cushioned to protect against undue motion and to ensure an open airway.

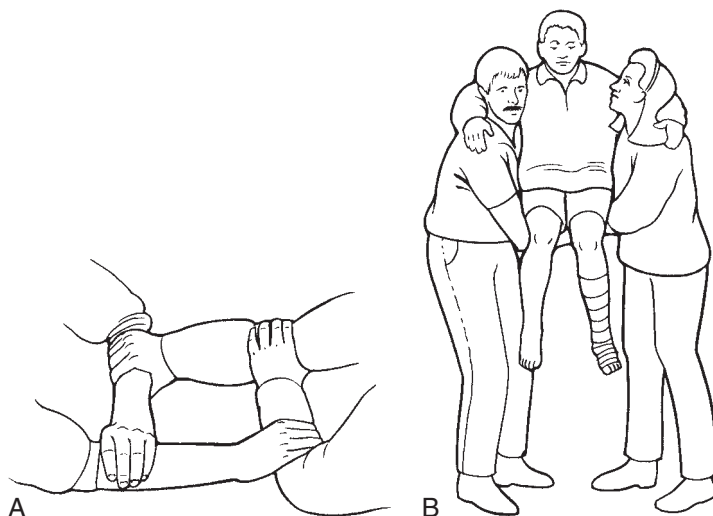


Figure 236. **A**, Overlapping hands to create a four-hand seat. **B**, Carrying the victim.

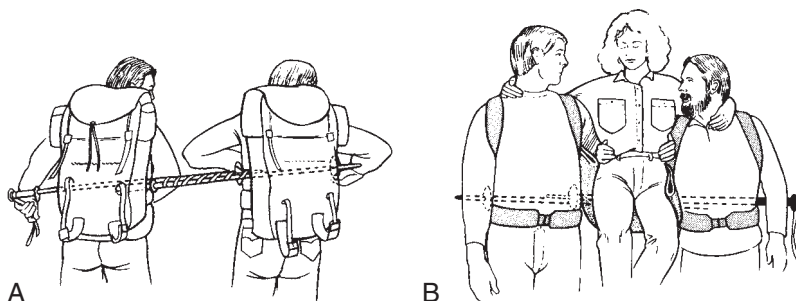


Figure 237. Fashioning a ski pole seat. **A**, The poles are slung between rescuers wearing backpacks. **B**, A victim can sit comfortably on the padded ski poles.

If a specialized litter or stretcher (such as a Stokes basket or split scoop frame) is not available, an improvised litter can be constructed from a blanket or sturdy drop cloth and two 6 to 7 ft (1.8 to 2.1 m) poles or sturdy tree limbs (saplings). Separate the poles by slightly more than the width necessary to carry the victim. Fold the blanket over one pole, then fold the edges over the other pole sequentially and back again over the first pole (Figure 240). Secure the outside blanket flap with safety pins or stitches of cord. Test it to be sure that it can support the victim. Carry the victim so that his body secures the outside (free) blanket flap. Be sure to immobilize the victim on the litter, and cushion his head and neck.

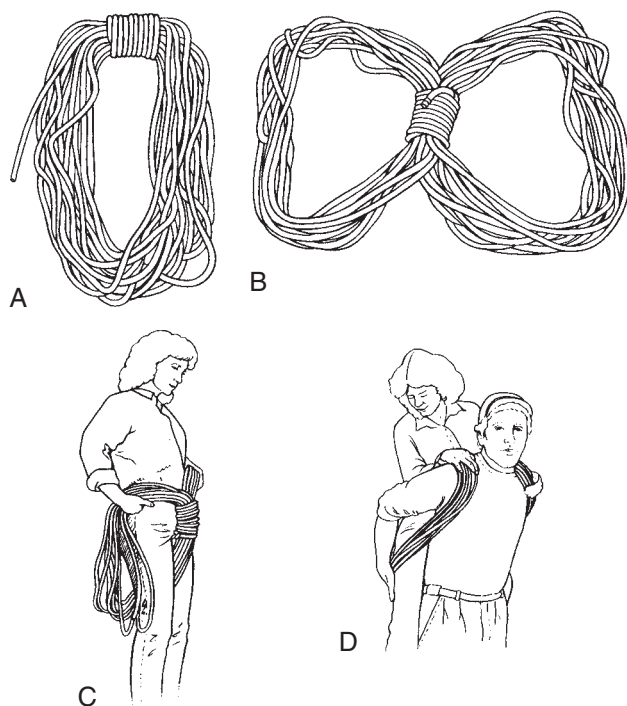


Figure 238. Creating a coiled rope seat. **A**, The rope is coiled and the loops secured. **B**, The loops of the coil are divided into equal sections at the point of fixation. **C**, The victim can step through the split loops. **D**, Thus, a single rescuer can carry the victim.



Figure 239. Two-rescuer split-coil rope seat.

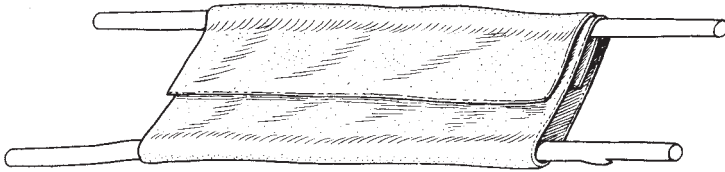


Figure 240. Blanket-pole litter.

Litters resembling ladders can be fashioned from tree limbs or ski poles fastened with twine, rope, clothing, or pack straps. Two backpack frames can be fastened together with tape or rope (Figure 241) to form a ladder-like platform for a sleeping bag or pads and blankets. A “parka litter” can be created by running two skis or long tree limbs through zipped jackets that are aligned bottom-to-bottom (Figure 242).

A rope stretcher is constructed by stretching a 150 to 200 ft (46 to 61 m) rope on the ground and determining its midpoint. At the midpoint, fold the rope back on itself. Measure 3 ft (91 cm) from the bend, and fold each half of the rope back again to the outside. This creates the central “rungs” of a “ladder” that will be 3 ft wide. Repeat the process of folding the rope back on itself in 3 ft segments, moving away from the central rungs in each direction and laying out a series of evenly spaced parallel loops. About 16 or 18 loops (rungs) should create a ladder approximately the same length as the victim. Take the two remaining long ends of the rope and lay them perpendicular to the rungs, alongside the bends in the rope (Figure 243). Use the long ends to secure the loops together (completing the long sides of the ladder) by tying a clove hitch (see Figure 259) or other secure knot onto each consecutive bend in the rope 2 to 3 in (5 to 7.5 cm) inside the bend, so that a small loop remains to the outside of the knot. Each pair of knots should be separated by 3 to 4 in (7.5 to 10 cm). After all the knots are tied, the rope ends are threaded through the small outside loops as the remaining lengths are circled around the outside of the stretcher and finally tied off.

A mummy litter (also called a daisy chain or cocoon wrap) can be constructed of a long climbing rope, large tarp, sleeping pads, blankets or a sleeping bag, and stiffeners (skis, poles, tree limbs, or the like). The rope is laid out with even U-shaped loops (Figure 244) that are roughly twice the victim’s width. Tie a

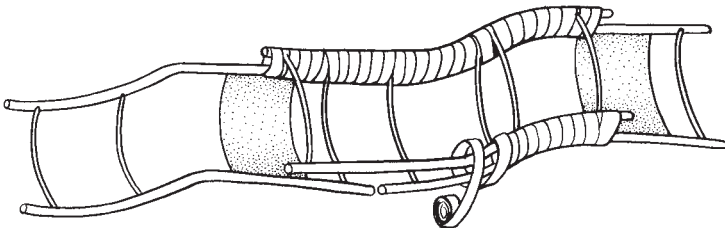


Figure 241. Construction of a backpack frame litter. Pads or a sleeping bag are placed on the litter.

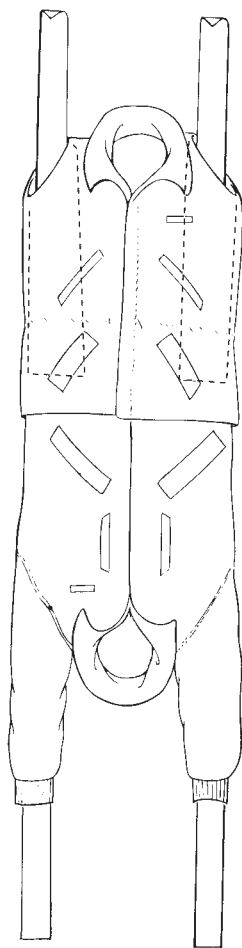


Figure 242. Parka litter.

small loop at the foot end of the rope. Lay a tarp on the rope. On the tarp, lay down foam pads, then lengthwise stiffening rods, then another layer of pads. Lay the victim on the pads, and cover with the sleeping bag or blankets. Pull the sides of the tarp up to wrap the victim. To secure him, bring the first untied loop above the tied end (foot) loop through the tied loop, and pull it toward the center. Moving toward the head, feed the next loop through the preceding loop, and so on until the armpits are reached. At this point, bring a loop up over one shoulder and tie the rope off in front of the victim after bringing the rope end over the opposite shoulder.

Test any litter on an uninjured person before trusting it to bear the weight of the victim. Be certain to fasten the victim securely into the stretcher or litter, so that he doesn't fall out. Pad all injuries, and the head and neck in particular, to make the victim as comfortable as possible. Positioning on a litter is very important. In general, keep the injury uphill, to keep extra weight (pressure) and jostling

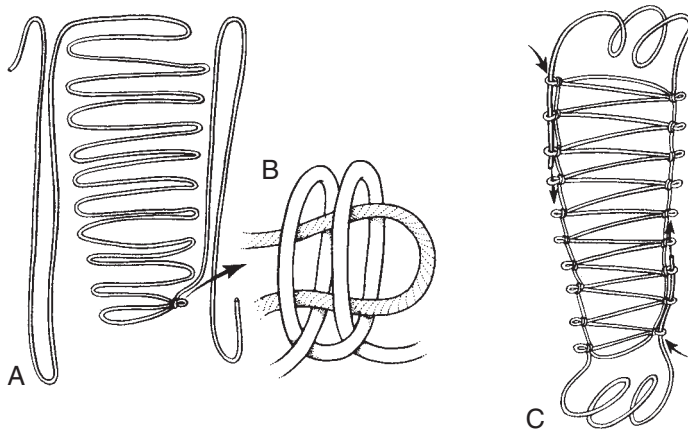


Figure 243. Making a rope stretcher. **A**, Having laid a series of parallel loops, lay the lengthwise segments perpendicularly alongside. **B**, Use a clove hitch to secure the loop ends. **C**, The remaining long ends of the rope are passed through the outside loops to form the perimeter of the stretcher, and are tied off to complete the process.

from causing pain. If the chest is injured, keep the victim lying on his side with the wounded side (lung) down, to allow the good lung to expand more fully. If the victim has altered consciousness, is nauseated, or is vomiting, he should be kept on his side, to protect the airway (see page 24). If the victim has suffered a face, head, or neck injury, he should be transported with his head slightly elevated. Victims with shock (see page 60), bleeding, or hypothermia (see page 305) should be carried with the head down and feet elevated. Victims with chest pain and/or difficulty breathing, which might indicate a heart attack or heart failure (see page 47), should be carried with the upper body elevated.

All victims should be covered above and below with blankets, clothing, sleeping bags, or whatever else is available for warmth. Handle all suspected hypothermics gently. A victim secured to a stretcher should never be left unattended. Constantly reassure the victim. If the terrain is steep, keep his feet pointed downhill. Litter transport is exhausting for the rescuers and should not be entertained if the distance to be covered is more than a few miles.

If possible, position at least one rescuer at the head of the victim, one at each shoulder, one at each hip, and one at the legs. This allows a litter to be carried and facilitates a quick action to turn the victim, should that be necessary. A leader should call out all activities of the team.

HELICOPTERS

Most helicopters used for medical evacuation can safely land at altitudes of up to 10,000 ft (3,050 m) and are limited by visibility, landing space, and weather conditions. Rescue helicopters may operate under visual flight rules ("VFR"), which

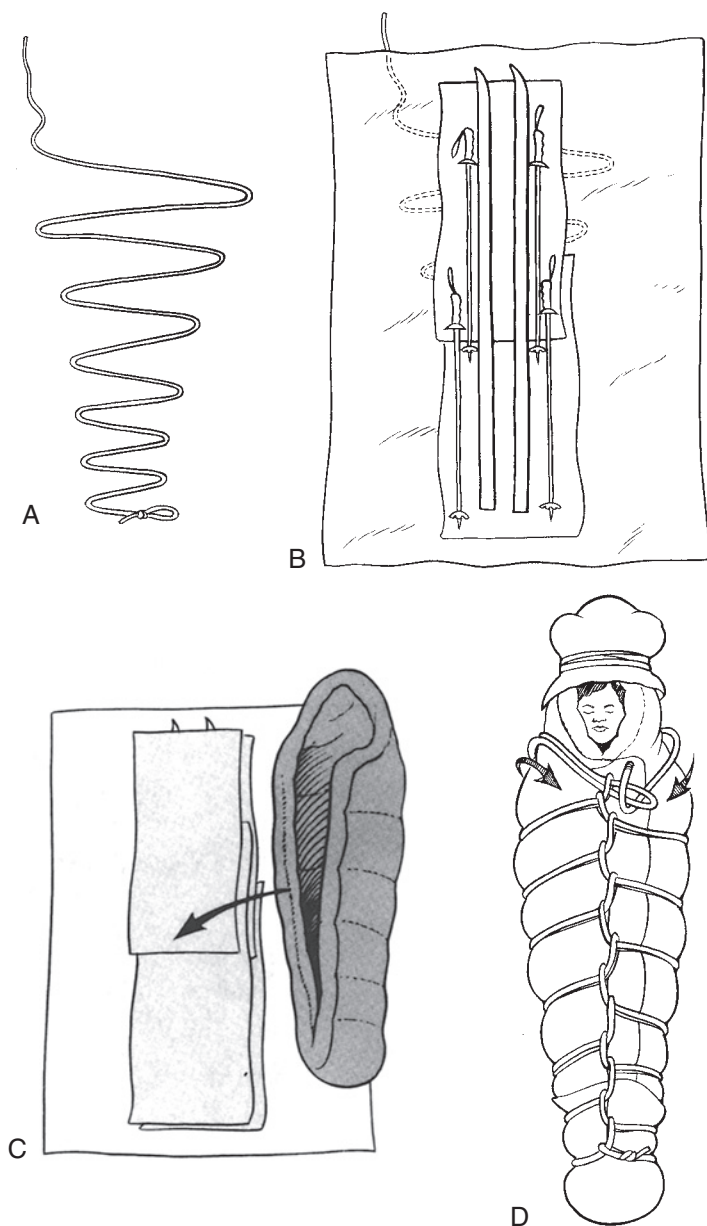


Figure 244. Mummy litter. **A,** Lay out the rope in even loops. **B,** Lay blankets or tarps over the loops, and then long, rigid objects for stability. **C,** Place a sleeping bag or blanket in the center to hold the victim. **D,** Pass the first nontied loop through the tied loop and work your way to the top. Bring the finishing loop and rope end over the shoulders, and tie off.

means that flight conditions must be free of clouds and where airspeed can be slow enough for the pilot to see far enough to avoid a collision. Larger military and search and rescue helicopters can fly under instrument flight rules ("IFR"), using special navigational instruments, and can land at higher altitudes.

When calling for a helicopter, provide the following information: number of victims and their weight, injuries, and level of consciousness; reason why you need a helicopter; location of the landing zone; and the current and expected weather conditions (temperature, visibility, distance ["ceiling"] from ground to clouds, and wind speed/direction). People on the ground should be aware of the limitations of maneuverability, and should obey certain rules when involved with a helicopter rescue:

1. Prepare and brightly mark a proper landing site. The ideal location is on level ground (bare rock is best; snow is worst) with no more than 10 degrees of incline and access from all sides. If possible, choose a site where the helicopter will be able to drop off during takeoff, rather than having to climb up. It is also desirable to have a helicopter take off or land into the wind, to increase lift. Ideally, there will be 360-degree access so that the helicopter can take off in any direction, depending on wind conditions. Clear an area 100 ft (31 m) long by 100 ft wide of all debris that could interfere with landing or be scattered by gusts from the propellers. Although the absolute minimum ground dimensions for a "safety square" can, under ideal weather and visibility conditions, be somewhat less than this, you should clear the full area (or even up to 100 ft (31 m) by 300 ft (93 m)), as a helicopter can rarely take off or land strictly vertically, particularly in the thinner air of high altitude. A smoky fire or smoke signal should be placed near the landing site so that the pilot can judge the wind (pilots prefer takeoffs and landings to be directed into the wind). If this is not possible, stand away from the landing site where the pilot can see you, and hold up an improvised wind flag (such as streamers), or position yourself with the wind behind your back, and point with both arms at the landing site. At night, if you have lights, shine them on objects that will alert the pilot to unseen danger (such as the poles of power lines). If there is a danger at the last minute before landing, signal "do not land" to the helicopter pilot by lifting your arms from a horizontal (to-the-side) outstretch to straight overhead several times. (Remember that waving your arms and hands frantically is the universal "wave-off" instruction!) If the landing area is on snow, place some large markers, such as backpacks, near the landing spot to offer the pilot some depth perception. At night, create a landing area at least half again as large as during the daytime, and position lights or small fires in the corners, pointing down at the ground rather than up into the air. Never shine a flashlight directly at a helicopter, to avoid blinding the crew. If fires are used, remember that the helicopter may scatter embers, so watch carefully for unintended fire spread. Minimize the number of people approaching the helicopter.

2. To summarize hand signals for guiding a helicopter pilot into a landing, stand with your back to the wind and extend both arms directly toward the landing area, which signifies where to land and that the wind is at your back. As the helicopter hovers over the proper landing site, extend your arms to the sides with clenched fists, which signifies to the pilot to hold the hover. As the helicopter begins to touch the ground, move your arms down at a 45-degree angle to the ground with hitchhiker thumbs pointing downward, signifying to the pilot to hold the ground position. When you want the rotors to be turned off, slice your hand across your neck with the palm pointed down.
3. Unless otherwise instructed, stay at least 150 ft (46 m) from a helicopter with rotors spinning. Look away as the ship lands, so as not to be struck in the face or eyes by flying debris. Protect the victim. Secure all loose objects or clear them from the landing area. Coil and secure all ropes. Because of the strong gusts from the approaching helicopter (up to 100 mph, or 161 km per hour), do not stand near the edge of a cliff! Do not stand in the landing zone if on snow, in case the helicopter settles.
4. Always approach or leave a helicopter at a 30- to 45-degree angle from the front, in sight of the pilot and crew (Figure 245). Never approach the helicopter from ground higher than the landing spot, to avoid walking into a rotor. Stay away from the tail rotor, because it is nearly invisible when rotating. All loading and unloading of a helicopter should occur on the downhill side of the aircraft, to avoid striking a rotor.
5. Keep your head down! You may not perceive that the rotor blade is dipping (up to 4 ft, or 1.2 m, from the center attachment) until it chops your head off. Don't hold any objects (particularly not your arms) above your head. Protect your eyes from dust kicked up by the rotor wash.
6. Do not smoke a cigarette near a helicopter.
7. Follow the pilot's and flight crew's instructions. Do not approach, enter, leave, or load a helicopter until he gives the command. Establish eye contact with the pilot and obey his signals.
8. Do not stand under or anywhere near a helicopter during takeoff or landing. Everyone near the landing site should stay at a safe distance in a single group, clearly visible to the pilot. At night, carry a light or wear a reflective object or clothing.
9. If a cable or rope is lowered, allow it to touch the ground before you handle it, to avoid a shock from static electricity. Never tie the rope or cable to an immovable object on the ground; this could cause a crash.
10. If a rescue device (e.g., litter) is being used, put the victim into the rescue device and take care to keep the hoist cable clear of looping around anyone in the area. Be certain that the victim is properly strapped into the rescue device before anyone signals to haul up the cable.
11. All people should wear hard hats and eye protection, if available. Keep jackets zipped. Carry all packs, rather than wear them on your back.

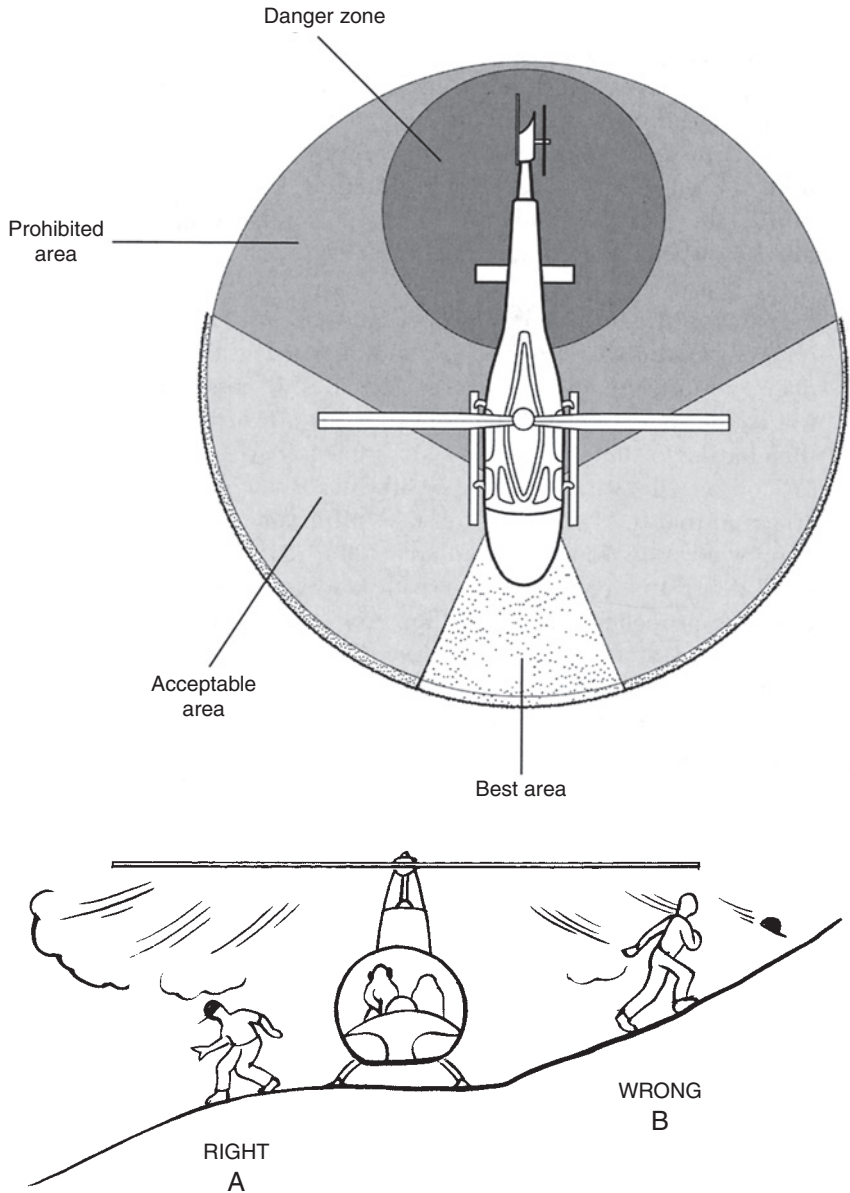


Figure 245. Approach zones around a helicopter. **A**, It is best to approach from the front. **B**, Don't walk uphill into the helicopter rotor blades.

GROUND-TO-AIR DISTRESS SIGNALS

If a party is trapped or lost, and helicopter or airplane search parties are likely to be in the region, it may help to attempt to signal the aircraft. One way that this can be done is by creating ground-to-air distress signals, either by marking an open field or a riverbank that is visible from the air by stamping out large (8 to 10 ft, or 2.4 to 3 m) designs in the snow (in an open area), or by attracting attention with display patterns of clothing, rocks, fire rings, or the like. Figure 246 illustrates some standard ground markings for communication.

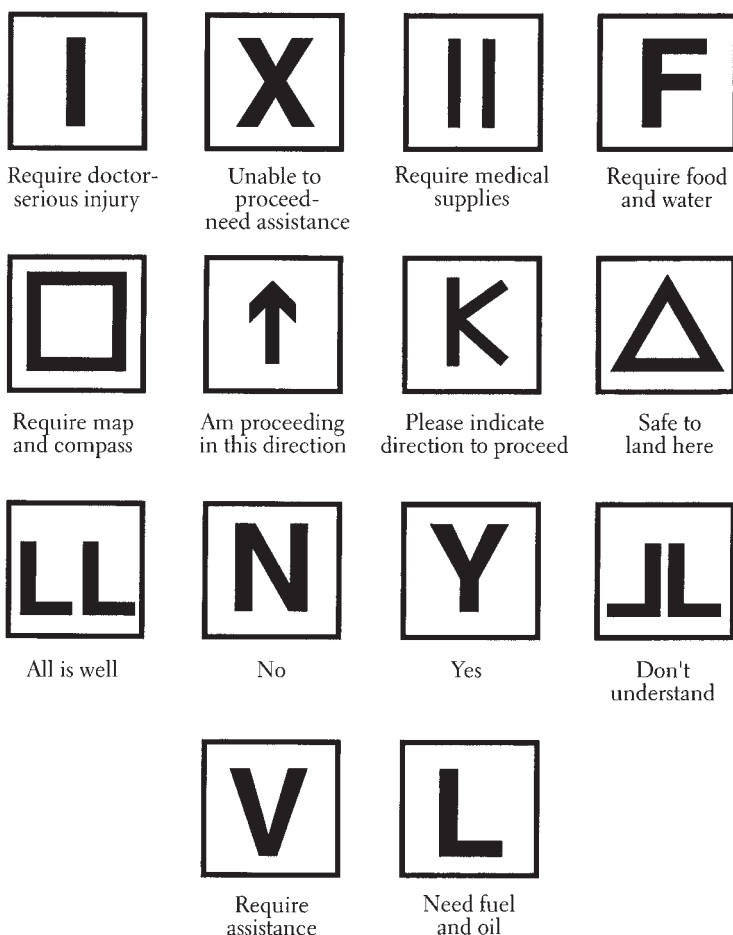


Figure 246. Ground-to-air signals.

The three signals that are recognized (and remembered) by most pilots are: three of anything—"distress"; large X—"unable to proceed" or "need medical assistance"; and an arrow—"proceeding in this direction." Three fires (set 100 ft, or 31 m, apart) placed in a triangular configuration is a sign of distress to a passing pilot. Ground-to-air patterns should be large, composed of straight lines, and made up of colors that contrast sharply with the natural colors of the environment (royal blue is best). Small battery-powered emergency strobes are also useful. A heliograph mirror is a small signal reflector that can be accurately aimed to reflect sunlight at a distant object (such as an aircraft).



People lost in the wilderness often act in a predictable manner. Rapid location of a lost person can make the difference between life and death. These general guidelines may assist you in a search:

1. Lost people tend to follow the path of least resistance (open fields, trails, roads, dry streambeds).
2. A person who is lost tends to travel downhill and to seek apparent shortcuts toward civilization or a familiar location.
3. People tend to avoid barriers and obstacles (lakes, large rivers, boulder fields, dense brush).
4. At night, a lost person tends to travel toward lights.
5. In bad weather, people tend to seek shelter with overhead protection.
6. Small children tend to seek shelter when tired.



PROCEDURES

SUBCUTANEOUS INJECTION

Subcutaneous (just below the skin) injection of epinephrine is used to manage a severe allergic reaction. The injection may be performed with a preloaded syringe (already containing the medicine in the barrel—see page 491) or may require that the medicine be drawn up for administration. After you wash your hands, follow these instructions:

1. Select the proper syringe and needle. For the treatment of an allergic reaction, a syringe that holds 1 milliliter (mL) is necessary, commonly equipped with a 25- or 27-gauge needle (the larger the gauge number, the smaller the diameter of the needle).
2. Never touch the metal of the needle with your hands.
3. Never share needles (never use the same needle to inject multiple people).
4. If the medication is in a preloaded syringe, be sure to see that the amount of medicine does not exceed the dose you want to administer. Be certain not to inject too much medicine.
5. If the medicine is in a glass vial, flick the vial a few times with your finger to drive the air bubble to the top, and then snap the vial open at the line marked on the glass at the neck (Figure 247, A and B). Draw the proper amount of medicine to be administered up into the syringe (Figure 247, C). In the case of epinephrine, this will be 0.3 to 0.5 mL for an adult, and 0.01 mL/kg (2.2 lb) of body weight for a child, not to exceed 0.3 mL.
6. If the medication is in a glass bottle with a rubber top, wipe the top of the bottle with alcohol, stick the needle through the rubber, and draw up the desired amount of medication. If you cannot draw the medicine out of the bottle, you may need to inject some air into the bottle first (use the same entry into the bottle to inject air in and to draw medicine out).
7. Before injection, point the needle upward, tap the syringe a few times to float the air bubbles to the top, and squirt out any air that is in the syringe (Figure 247, D and E). You should be left with only medicine. Try not to inject any air.
8. Wipe off the skin with alcohol or with soap and water (if no alcohol is available) where you intend to administer the medicine. The easiest place to inject epinephrine is on the lateral arm at the shoulder.
9. Pinch the skin up between your fingers, and quickly plunge the needle in just under the skin at a 15- to 30-degree angle to the skin (Figure 247, F). With the needle in the skin, gently pull back on the plunger, to see if

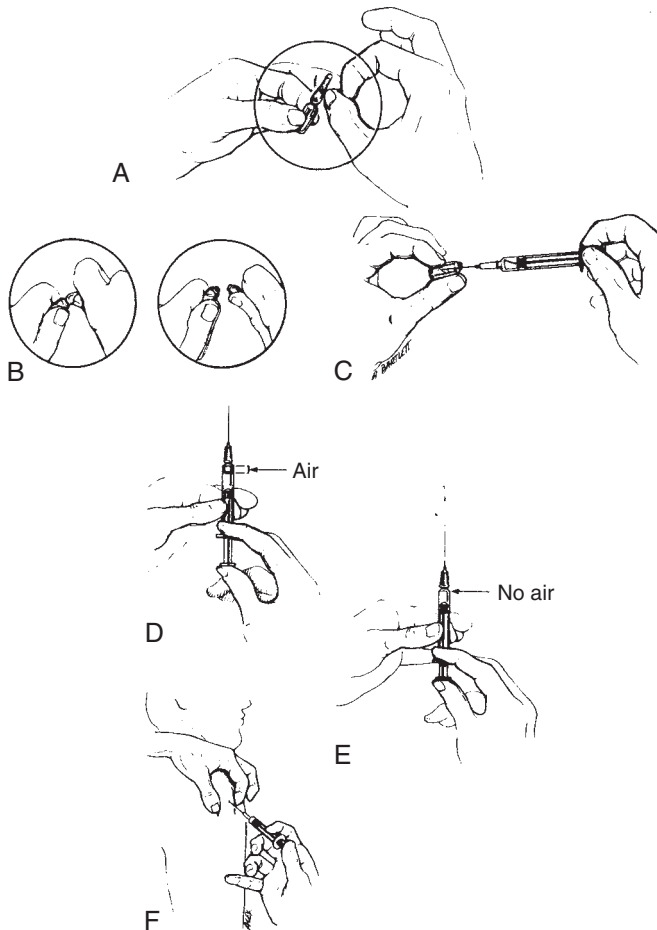


Figure 247. Administering an injection. **A**, Flick the air bubble to the top of the vial. **B**, Break off the top of the vial at the narrowing or line. **C**, Draw the medicine into the syringe. **D**, Holding the needle straight up, gently push the plunger until **(E)** no air is left. **F**, Pinch up a fold of skin and briskly stick the needle through the skin.

blood enters the syringe. If it does, you have inadvertently entered a blood vessel, and you should draw back the needle until no blood is returned. If no blood is returned, firmly plush the plunger and inject the medicine. Quickly remove the needle from the skin, and gently massage the injection site.

Again, when administering an injection, *never* share needles between people.

FISHHOOK REMOVAL

If a fishhook enters the skin, gently scrub the skin surrounding the entry point with soap and water. After the skin is clean, apply gentle pressure along the curve toward the point while pulling on the hook. If the hook is not easily removed, this means that the barb is caught in the tissue (Figure 248, A).

If the hook has a barbed shank, the hook can be removed by pushing it through the skin. This should be done (because of the increased risk of infection) if it will take more than 8 hours to get to a doctor. Grasp the shank of the hook with a pliers. With a steady, firm motion, push the hook through the skin so that the barb appears (Figure 248, B). Cut off the shaft or the barb (take care to cover the area with a free hand to prevent the detached barb from flying into someone's eye) and then pull the remainder of the hook back out of the skin (Figure 248, C and D).

A method of fishhook removal that has become extremely popular is the "string-pull" or "press-and-yank" technique (Figure 248, E). Attach (tie) a shoe-lace or 2 ft (60 cm) length of string, fishing line, or rolled gauze around the bend of the hook. Push the shank of the hook down (toward the barb), parallel to the skin. This (hopefully) will disengage the barb from the tissue. Then use the string (at a 30-degree angle) to yank the hook from the skin in a snapping motion. Take care that the flying hook released from the skin does not impale anyone nearby. Wear eye protection or look away when you pull on the string to remove the hook.

Vigorously wash the wound and leave it open with a simple dry dressing. Do not seal in the dirt and bacteria with any grease or home remedies. If the hook was dirty (or was holding a dirty worm), begin the victim on dicloxacillin, penicillin, erythromycin, or cephalexin. If the victim suffers from a depressed

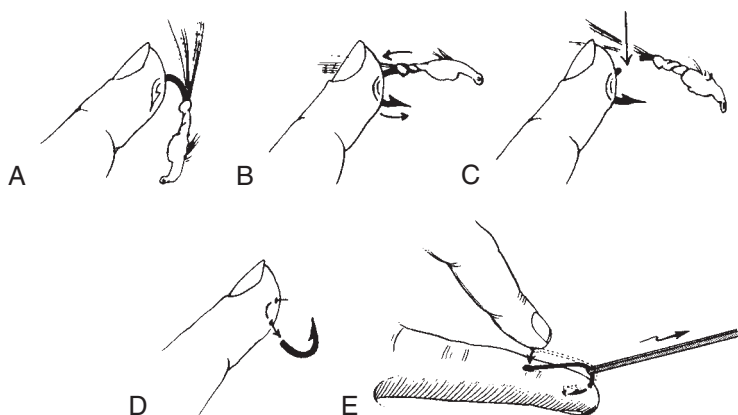


Figure 248. Fishhook removal. **A**, The barb is embedded in the finger. **B**, The hook and barb are pushed through the skin. **C**, The shaft of the hook is cut. **D**, Both pieces are easily extracted. **E**, "Press-and-yank" method of fishhook removal.

immune system, use an antibiotic that is effective against germs acquired in an aquatic environment (see page 354). If a hook enters the skin anywhere near the eye, do not attempt removal. Tape the hook in place so that it cannot be snagged, and take the victim immediately to see a doctor.

SPLINTER REMOVAL

A splinter can be removed by gently cutting away the skin near the entrance, until a firm grasp can be made with a small tweezers or with the fingers. If a splinter enters the finger under the fingernail, cut a small V-shaped wedge out of the nail, so that the splinter can be grasped. If a splinter cannot be removed for more than 24 hours, begin the victim on penicillin, erythromycin, or cephalexin.

If a splinter lies in full view longitudinally under the skin, it may be easier to take a sharp blade and carefully cut down through the skin directly over the splinter along its entire length, to avoid fragmenting it by dragging the (usually) wood out of a small opening.

RING REMOVAL

A ring should be removed if swelling of a finger underneath will cause the ring to become an inadvertent tourniquet. This is particularly true with broken fingers, burns, crush injuries, stings, and bites. The easiest method is to lubricate the skin with soap, ointment, or something greasy, and then apply a circular motion with traction on the ring. Keep the hand or foot (for a toe ring) elevated and cool (cold water or ice pack for 10 minutes) to minimize the swelling.

If swelling prevents easy removal, use the “string-wrap” technique (Figure 249). Take a 20 in (50 cm) string and pass it under the ring so that the long portion is left on the fingernail side of the ring. Wrap the long portion around the finger in a spiral fashion, starting next to the ring and working out toward the fingernail, keeping the loops close together. No tissue should bulge through between the loops. The string is then unwrapped by unwinding on the side closer to the hand, which pushes the ring little by little off the finger. The process is repeated over and over until the ring can be forced over the swollen finger joint(s), which may be a bit painful. Take care between wraps not to lose ground by inadvertently pushing the ring back toward the hand.

ZIPPER REMOVAL

If skin gets caught in a zipper (ouch!), the best way to solve the problem is to cut the diamond-shaped slider with a wire cutter so that the zipper falls apart. If you keep trying to slide the zipper, you may entrap more skin.

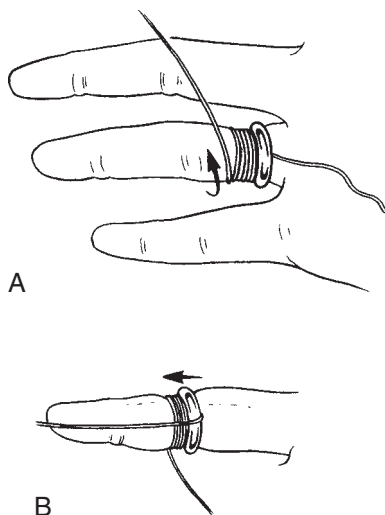


Figure 249. Ring removal. **A**, Thread a string under the ring. Wrap the long portion to compress the finger next to the ring. **B**, Unwrap the string to push the ring toward the end of the finger. The process is repeated until the ring is moved over the knuckle or swollen part of the finger.

KNOTS AND HITCHES

One of the most useful wilderness skills is the ability to quickly tie a secure knot or hitch. This is particularly important when fashioning a litter or traction device. The following diagrams illustrate a selection of common useful knots, hitches, and bends: overhand knot (Figure 250), slip knot (Figure 251), figure-eight knot

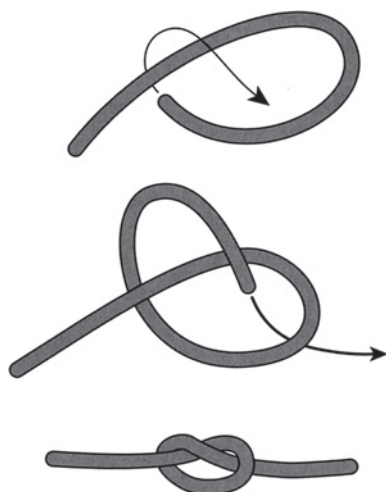


Figure 250. Overhand knot.

(Figure 252), half hitch and double half hitch (Figure 253), bowline (Figure 254), double bowline (Figure 255), loop knot and draw loop (Figure 256), round turn with double half hitch (Figure 257), single sheet bend (Figure 258), clove hitch (Figure 259), double carrick bend (Figure 260), prusik hitch (Figure 261), and double fisherman's bend (Figure 262).

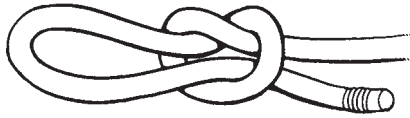


Figure 251. Slip knot.

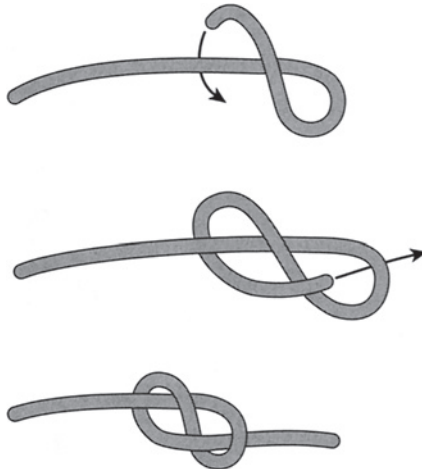


Figure 252. Figure-eight knot.

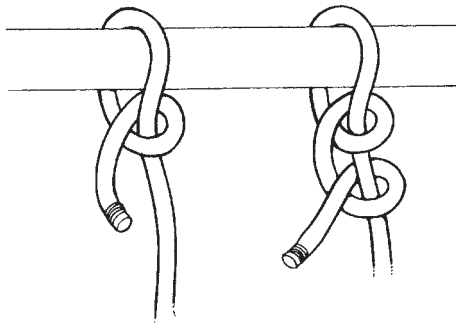


Figure 253. Half hitch and double half hitch.

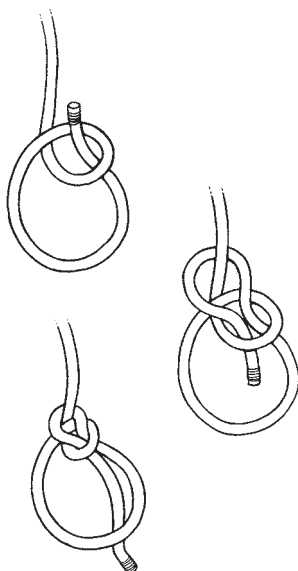


Figure 254. Bowline.

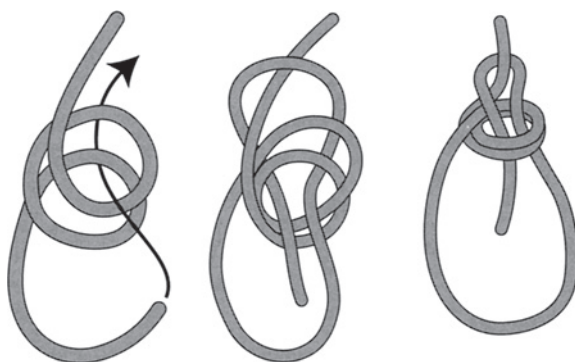
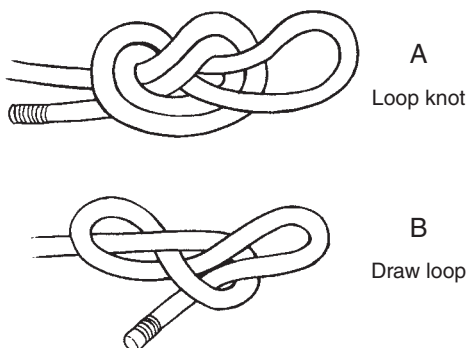


Figure 255. Double bowline.



A
Loop knot

B
Draw loop

Figure 256. A, Loop knot. B, Draw loop.

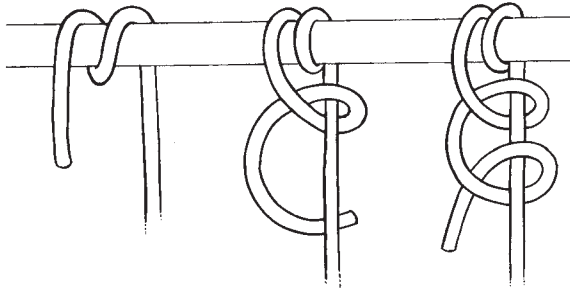


Figure 257. Round turn with double half hitch.

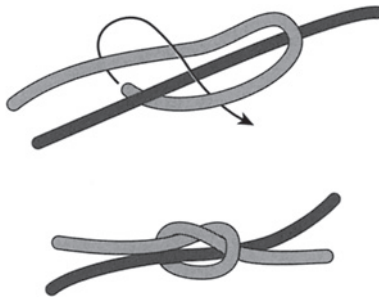


Figure 258. Single sheet bend.

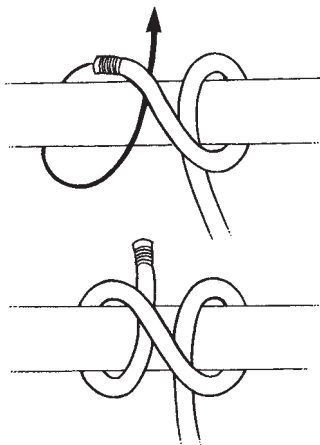


Figure 259. Clove hitch.

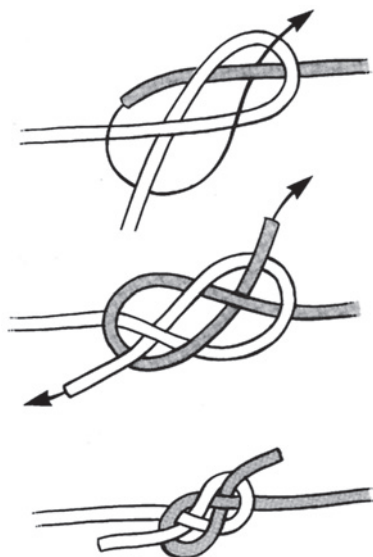


Figure 260. Double carrick bend.

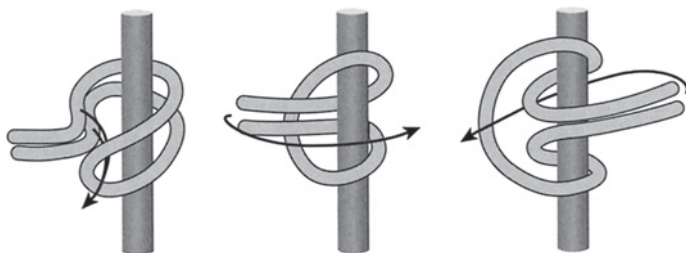


Figure 261. Prusik hitch.

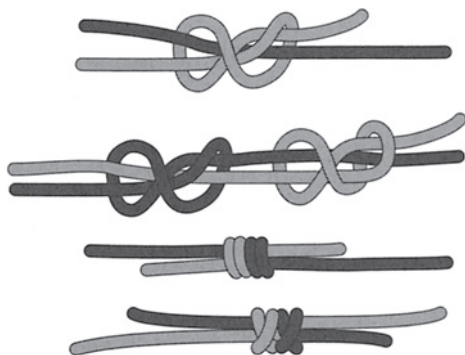
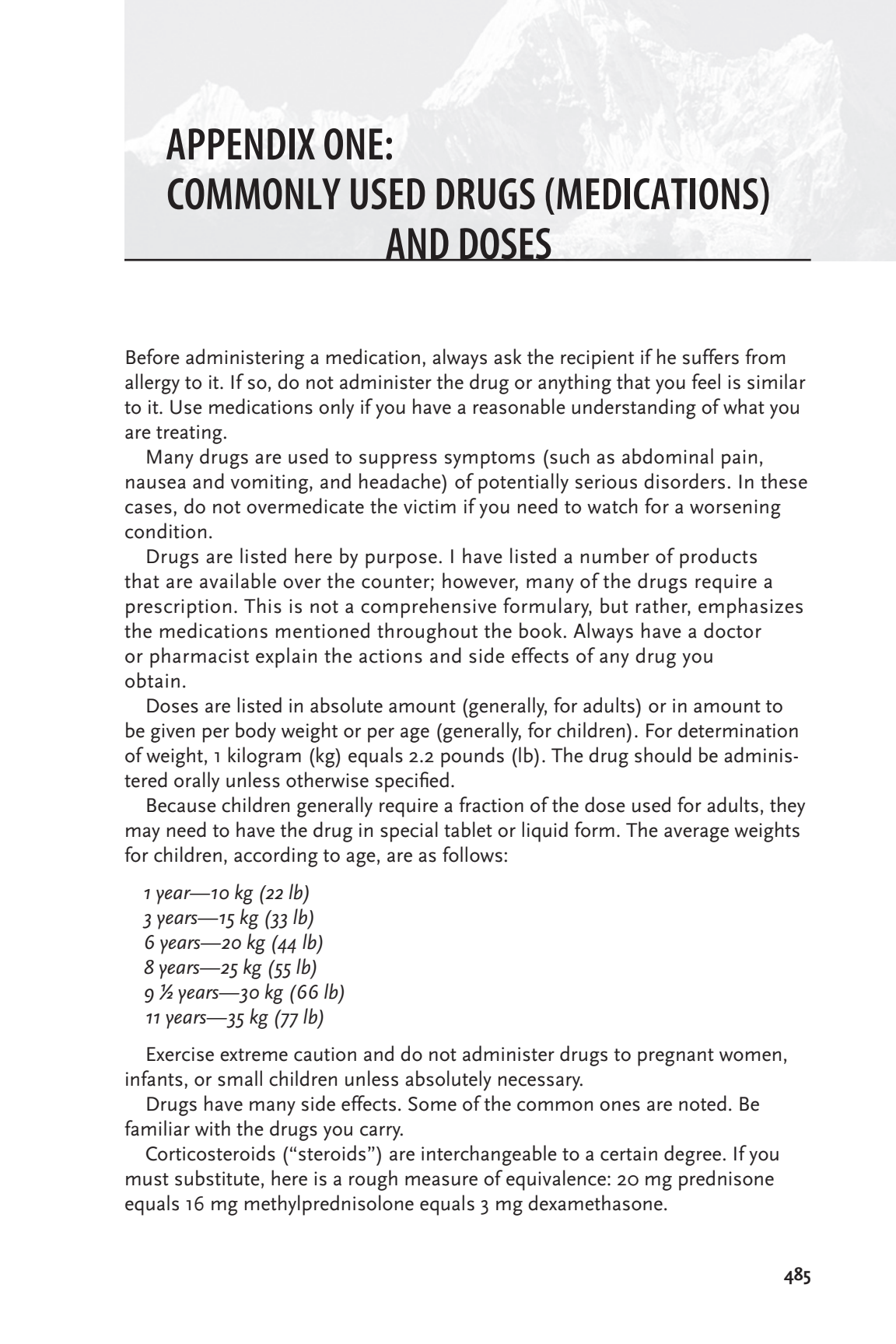


Figure 262. Double fisherman's bend.

Appendixes

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APPENDIX ONE: COMMONLY USED DRUGS (MEDICATIONS) AND DOSES

Before administering a medication, always ask the recipient if he suffers from allergy to it. If so, do not administer the drug or anything that you feel is similar to it. Use medications only if you have a reasonable understanding of what you are treating.

Many drugs are used to suppress symptoms (such as abdominal pain, nausea and vomiting, and headache) of potentially serious disorders. In these cases, do not overmedicate the victim if you need to watch for a worsening condition.

Drugs are listed here by purpose. I have listed a number of products that are available over the counter; however, many of the drugs require a prescription. This is not a comprehensive formulary, but rather, emphasizes the medications mentioned throughout the book. Always have a doctor or pharmacist explain the actions and side effects of any drug you obtain.

Doses are listed in absolute amount (generally, for adults) or in amount to be given per body weight or per age (generally, for children). For determination of weight, 1 kilogram (kg) equals 2.2 pounds (lb). The drug should be administered orally unless otherwise specified.

Because children generally require a fraction of the dose used for adults, they may need to have the drug in special tablet or liquid form. The average weights for children, according to age, are as follows:

1 year—10 kg (22 lb)
3 years—15 kg (33 lb)
6 years—20 kg (44 lb)
8 years—25 kg (55 lb)
9 ½ years—30 kg (66 lb)
11 years—35 kg (77 lb)

Exercise extreme caution and do not administer drugs to pregnant women, infants, or small children unless absolutely necessary.

Drugs have many side effects. Some of the common ones are noted. Be familiar with the drugs you carry.

Corticosteroids (“steroids”) are interchangeable to a certain degree. If you must substitute, here is a rough measure of equivalence: 20 mg prednisone equals 16 mg methylprednisolone equals 3 mg dexamethasone.

Drugs are listed in the following order:

- *For relief from a severe allergic reaction (page 491)*
- *For relief from a mild allergic reaction (page 492)*
- *For relief from severe asthma (page 493)*
- *For relief from mild (or chronic) asthma (page 494)*
- *For relief of chest pain (angina) (page 495)*
- *For treatment of congestive heart failure (page 496)*
- *For treatment of seizures (epilepsy) (page 496)*
- *For relief from pain (page 496)*
- *For relief from fever (page 497)*
- *For relief from muscle aches or minor arthritis (page 497)*
- *For relief from migraine headache (page 497)*
- *For relief from itching (page 498)*
- *For relief from toothache (page 498)*
- *For relief from motion sickness (page 498)*
- *For relief from nausea and vomiting (page 499)*
- *For relief from diarrhea (page 499)*
- *For relief from constipation (page 500)*
- *For relief from ulcer pain (page 501)*
- *For relief from indigestion or gas pains (page 501)*
- *For relief from heartburn (reflux esophagitis) (page 502)*
- *For relief from nasal congestion (page 502)*
- *For relief from cough (page 503)*
- *For relief from sore throat (page 503)*
- *Cold formulas (page 503)*
- *Skin medications (page 504)*
- *For sleep (page 506)*
- *Antibiotics (page 507)*

DRUGS AND PREGNANCY

In general, it is best to avoid taking any medication when pregnant to avoid the risk of fetal malformation, or illness or injury in the newly born child. A pregnant woman should be discouraged from taking over-the-counter drugs. However, women can certainly become ill during pregnancy, so it is important to know what can be administered safely and what should be absolutely avoided. Fortunately, many of the drugs that are labeled “potentially hazardous” have only been proven hazardous in laboratory animals, frequently in relative doses that far exceed their common usage in humans. Furthermore, some drugs, such as diazepam and salicylates, formerly thought to cause malformation of the developing fetus have since been proven safe when administered in normal therapeutic doses.

The following list reflects recommendations compiled from the current medical literature. Whenever possible, a pregnant woman contemplating use of a medication should seek advice *in advance* from her physician.

Antibiotic, Antifungal, Antiviral, Antimalarial**NO RECOGNIZED HAZARD**

amoxicillin-clavulanate
penicillin
cephalosporins
erythromycin
clotrimazole
miconazole
nystatin
proguanil
ampicillin/amoxicillin
paromomycin
mefloquine (apparently safe)
terconazole
gentamicin topical eye medication

AVOID IF POSSIBLE

chloramphenicol
chloroquine (apparently safe)
ciprofloxacin
gentamicin injection
trimethoprim-sulfamethoxazole
metronidazole
nitrofurantoin
quinine
primaquine
quinacrine
acyclovir

HAZARDOUS

tetracycline/doxycycline (causes staining of teeth and altered bone development in fetus)
norfloxacin
ofloxacin
fleroxacin

Pain Medication**NO RECOGNIZED HAZARD**

acetaminophen
hydrocodone
meperidine
naproxen (use with caution in later pregnancy)
oxycodone

AVOID IF POSSIBLE

codeine

aspirin (but probably safe)

ibuprofen and most other nonsteroidal antiinflammatory drugs ("NSAIDs")
during later pregnancy

HAZARDOUS

indomethacin

Vaccine**NO RECOGNIZED HAZARD**

hepatitis A

hepatitis B (killed)

tetanus toxoid

diphtheria toxoid

tetanus immunoglobulin

pooled serum immunoglobulin

AVOID IF POSSIBLE

influenza (inactivated virus)

polio (oral and injection)

typhus

tuberculosis (BCG)

typhoid

cholera

yellow fever

meningococcal vaccine

pneumococcal vaccine

rabies vaccine (preexposure; must be used for postexposure)

HAZARDOUS

smallpox

measles

mumps

varicella

rubella

Antiallergy**NO RECOGNIZED HAZARD**

epinephrine (use only in a critical situation)

cimetidine

dimenhydrinate

famotidine
topical corticosteroids, decongestants (e.g., oxymetazoline)

AVOID IF POSSIBLE

chlorpheniramine
epinephrine (avoid in a noncritical situation)
hydroxyzine
prednisone

HAZARDOUS

diphenhydramine (during first trimester)
brompheniramine
dimenhydrinate
cyclizine

Antinausea, Anti-Motion-Sickness, Antidiarrheal, Anticonstipation**NO RECOGNIZED HAZARD**

trimethobenzamide
prochlorperazine
promethazine
ondansetron
dimenhydrinate
docusate
bisacodyl
mineral oil
meclizine
metoclopramide (apparently safe)

AVOID IF POSSIBLE

scopolamine
anticholinergic drugs

Other**NO RECOGNIZED HAZARD**

antacids
caffeine
cyproheptadine
prednisone
betamethasone
dextromethorphan
casanthranol
prednisolone

kaolin-pectin
loperamide
lindane (use with caution)
omeprazole
oxymetazoline
pyrethrins with piperonyl butoxide
ranitidine
simethicone
sucralfate

AVOID IF POSSIBLE

albuterol
amantadine
beclomethasone
bismuth subsalicylate
dexamethasone
furosemide
isoproterenol
acetazolamide
triazolam
loperamide
diphenoxylate
theophylline
metaproterenol
nifedipine

HAZARDOUS

thyroid inhibitors
captopril (and all other angiotensin-converting enzyme ["ACE"] inhibitors)
chlorthalidone
chlorothiazide
isotretinoin
phenacetin
phenytoin
dapsone
diazepam
hydrochlorothiazide
tolbutamide
midazolam

ALLERGIC REACTION TO A DRUG

If a person develops an allergic reaction to a drug (itching, shortness of breath, swollen tongue, difficulty talking, skin rash, hives, and so on), immediately discontinue the drug and follow the instructions on page 66.

FOR RELIEF FROM A SEVERE ALLERGIC REACTION

Epinephrine (adrenaline) 1:1,000 aqueous solution. Adult dose 0.3 to 0.5 mL injected subcutaneously (see page 474). This may be repeated two times at 20-minute intervals. The pediatric dose is 0.01 mL /kg (2.2 lb) of body weight, not to exceed 0.3 mL, injected subcutaneously. *Unless the situation is life threatening, do not use epinephrine if the victim is older than 45 years, has a known history of heart disease, or is a pregnant female.*

Side effects: rapid heartbeat, nervousness.

Epinephrine is available in preloaded syringes in certain allergy kits, which include the Twinject (Verus Pharmaceuticals), the Ana-Kit, and the EpiPen autoinjector and EpiPen Jr. autoinjector (Dey). Instructions for use accompany the kits. The Twinject and EpiPen epinephrine products are generally easier for laypeople to use, because they require less manual dexterity to accomplish the injection. The Twinject autoinjector and Ana-Kit preloaded syringe carry enough epinephrine for a second (repeat) adult dose given by routine injection, which is necessary in one out of six episodes of severe allergic reactions. For dosing purposes, the Twinject and EpiPen autoinjectors (0.3 mg per dose) should be used for adults and children over 66 lb (30 kg) in weight. Children 66 lb and under should be injected with the Twinject 0.15 mg or EpiPen Jr. autoinjector.

Take particular care to handle preloaded syringes properly, to avoid inadvertent injection into a finger or toe. Do not intentionally inject epinephrine into the buttocks or a vein. Epinephrine should not be exposed to heat or sun, but does not need to be kept refrigerated. If clear (liquid) epinephrine turns brown, it should be discarded.

When administering an injection, *never* share needles between people.

Diphenhydramine (Benadryl). Adult dose 25 to 50 mg every 4 to 6 hours; pediatric dose 1 mg/kg (2.2 lb) of body weight.

Side effects: drowsiness, paradoxical hyperactivity (children).

Albuterol (Ventolin) or metaproterenol (Alupent) metered-dose inhaler. Adult dose 2 puffs every 3 to 6 hours as needed.

Side effects: rapid heartbeat, nervousness (“jitters”).

The proper technique for using a metered-dose inhaler device is as follows:

1. Shake the inhaler vigorously for 5 seconds before each use.
2. Invert the inhaler so that the opening is downward if directed to do so. Hold the inhaler 4 cm (1.6 in) in front of an open mouth, or place a spacer on the opening, around which the lips will be sealed.
3. Exhale fully. Close your lips around the spacer, or hold it about 4 cm (1.6 in) from your mouth, or close your lips around the mouthpiece.
4. Activate the inhaler at the beginning of inspiration.
5. Inhale slowly and deeply to full lung capacity.

6. Hold your breath for 10 seconds, then exhale slowly.
7. Wait one minute before repeating all steps before the next puff. Shake the inhaler before each puff.

Prednisone. Adult dose 50 to 80 mg the first day. Each day, the dose is decreased by 10 mg. The pediatric dose is 1 mg/kg (2.2 lb) of body weight the first day, tapered every 4 days by halving the dose. Administer with food or with an antacid if possible.

For a severe skin reaction to poison ivy, oak, or sumac, see the instructions on page 234. For a severe sunburn, see the instructions on page 227.

Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

FOR RELIEF FROM A MILD ALLERGIC REACTION OR HAY FEVER

Diphenhydramine (Benadryl). Same as "For Relief from a Severe Allergic Reaction." *Diphenhydramine (25 mg) with pseudoephedrine (60 mg) (Benadryl Decongestant).* Adult dose one tablet every 8 hours.

Cetirizine hydrochloride (Zyrtec). Dose 5 to 10 mg a day; do not use in children under 6 years of age.

Fexofenadine (Allegra). Adult dose 60 mg every 12 hours. In adults, it may also be administered as 180 mg once a day. Rarely causes drowsiness. Do not use in children less than 12 years of age. This drug replaces terfenadine (Seldane), and should be used in preference to that medication. If for some reason terfenadine is used, observe the following precautions: a person with impaired liver function or who is taking ketoconazole, itraconazole, erythromycin, clarithromycin, or troleandomycin should not take terfenadine at the same time. *Allegra-D:* fexofenadine 60 mg with pseudoephedrine 120 mg extended-release tablet.

Loratadine (Claritin). Adult dose 10 mg every 24 hours. Rarely causes drowsiness. Do not use in children less than 12 years of age. *Claritin-D:* loratadine 5 mg with pseudoephedrine 120 mg. *Claritin-D 24 Hour:* loratidine 10 mg with pseudoephedrine 240 mg.

Prednisone. Adult dose 50 to 80 mg the first day for severe seasonal allergies that do not respond to other medications. Each day, the dose is decreased by 10 mg. The pediatric dose is 1 mg/kg (2.2 lb) of body weight the first day, tapered every 4 days by halving the dose. Administer with food or with an antacid, if possible. Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

Triprolidine with pseudoephedrine (Actifed). Adult dose 1 tablet every 8 hours; pediatric dose (6 to 12 years of age) half tablet every 8 hours.

Side effect: drowsiness.

FOR RELIEF FROM SEVERE ASTHMA/CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

Many asthma/COPD medications are administered by metered-dose inhaler. The proper technique for using this device is as follows:

1. Shake the inhaler vigorously for 5 seconds before each use.
2. Invert the inhaler so that the opening is downward if directed to do so. Hold the inhaler 4 cm (1.6 in) in front of an open mouth, or place a spacer on the opening, around which the lips will be sealed.
3. Exhale fully. Close your lips around the spacer, or hold it about 4 cm (1.6 in) from your mouth, or close your lips around the mouth piece.
4. Activate the inhaler at the beginning of inspiration.
5. Inhale slowly and deeply to full lung capacity.
6. Hold your breath for 10 seconds, then exhale slowly.
7. Wait one minute before repeating all steps before the next puff. Shake the inhaler before each puff.

Epinephrine (adrenaline) 1:1,000 aqueous solution. Adult dose 0.3 to 0.5 mL injected subcutaneously (see page 474). This may be repeated two times at 20-minute intervals. The pediatric dose is 0.01 mL/kg (2.2 lb) of body weight, not to exceed 0.3 mL, injected subcutaneously. *Do not use epinephrine for treatment of COPD.*

The drug is available in preloaded syringes in certain allergy kits, which include the Twinject (Verus Pharmaceuticals) autoinjector, the Ana-Kit, and the EpiPen autoinjector and EpiPen Jr. autoinjector (Dey). Instructions for use accompany the kits. The EpiPen and Twinject epinephrine products are generally easier for laypeople to use, because they require less manual dexterity for injection.

For dosing purposes, the EpiPen or Twinject 0.3 mg dose autoinjector should be used for adults and children over 66 lb (30 kg) in weight. Children 66 lb and under should be injected with the EpiPen Jr. or Twinject 0.15 mg autoinjector. Take particular care to handle preloaded syringes properly, to avoid inadvertent injection into a finger or toe. Do not intentionally inject epinephrine into the buttocks or a vein. Epinephrine should not be exposed to heat or sun, but does not need to be kept refrigerated. If clear (liquid) epinephrine turns brown, it should be discarded.

Do not use epinephrine if the victim is older than 45 years, has a known history of heart disease, or is a pregnant female unless the situation is life threatening. Do not use epinephrine for treatment of COPD. When administering an injection, never share needles between people.

Primatene Mist (inhaler) is a mixture of epinephrine and alcohol available over the counter. This preparation should not be used in substitution for injected epinephrine in cases of severe asthma.

Side effects: rapid heartbeat, nervousness.

Terbutaline (Brethine) tablets. Adult dose 2.5 to 5 mg every 6 to 8 hours.

Terbutaline (Brethaire) metered-dose inhaler. Adult dose 2 puffs every 4 to 6 hours.

Flunisolide (Aerobid) metered-dose inhaler. Adult dose as directed.

Triamcinolone acetonide (Azmacort) metered-dose inhaler. Adult dose 1 puff twice a day for treatment of chronic asthma, equivalent to 10 mg per day of oral prednisone.

Albuterol (Ventolin) or metaproterenol (Alupent) metered-dose inhaler. Adult dose 2 puffs every 4 hours as needed.

Side effects: rapid heartbeat, nervousness ("jitters").

Ipratropium bromide metered-dose inhaler. Adult dose 2 puffs every 4 hours.

Tiotropium bromide dry-powder inhaler. Adult dose one puff a day.

Combivent (ipratropium bromide and albuterol sulfate) metered-dose inhaler. Adult dose 2 puffs four to six times a day, not to exceed 12 puffs in 24 hours.

Bitolterol (Tornalate) metered-dose inhaler. Adult dose 2 puffs every 8 hours.

Pirbuterol (Maxair) metered-dose inhaler. Adult dose 2 puffs every 4 to 6 hours.

Salmeterol xinafoate (Serevent) or formoterol fumarate dry-powder inhaler. Adult dose one puff every 12 hours. Longer-acting beta-2 agonists, such as salmeterol, have been associated with a worsening of asthma episodes with or without the use of shorter-acting beta-2 agonists, such as albuterol, so persons who take salmeterol should be watched carefully when they suffer an asthma attack.

Budesonide/formoterol fumarate dihydrate inhalation aerosol (Symbicort). Adult dose two inhalations twice daily.

Fluticasone propionate/250 micrograms plus salmeterol 50 micrograms (Advair Diskus). Adult dose 1 inhalation twice a day.

Metaproterenol (Alupent) tablets. Adult dose 20 mg every 4 to 6 hours; pediatric dose (6 to 9 years of age or less than 60 lb, or 27.2 kg, of body weight) 10 mg.

Albuterol (Ventolin) tablets. Adult dose 2 to 4 mg three to four times a day.

Cromolyn sodium (Intal) metered-dose inhaler. Adult and pediatric dose 2 puffs every 4 to 6 hours; not for use in children less than 5 years of age.

Theophylline. Adult dose 100 to 200 mg every 6 to 8 hours; pediatric dose 4 mg/kg (2.2 lb) of body weight every 6 to 8 hours.

Prednisone. Adult dose 50 to 80 mg the first day. Each day, the dose is decreased by 10 mg. The pediatric dose is 1 mg/kg (2.2 lb) of body weight the first day, tapered every 4 days by halving the dose. Administer with food or with an antacid, if possible. Corticosteroids should always be taken with the understanding that a rare side effect is serious deterioration of the head ("ball" of the ball-and-socket joint) of the femur, the long bone of the thigh.

FOR RELIEF FROM MILD ASTHMA

In addition to drugs under "For Relief from Severe Asthma":

Ipratropium bromide (Atrovent) metered-dose inhaler. Adult dose 2 puffs every 4 to 6 hours as needed. Do not exceed 12 puffs in 24 hours. Do not use in children less than 12 years of age.

Beclomethasone dipropionate (Vanceril) metered-dose inhaler. Adult dose 2 puffs every 4 to 6 hours, not to exceed 20 puffs in 24 hours; pediatric dose (6 to 12 years of age) 1 or 2 puffs every 6 hours, not to exceed 10 puffs in 24 hours. Rinse the mouth after each use.

Zafirlukast (Accolate). Adult dose 20 mg tablet twice a day taken 1 hour before or 2 hours following meals. Do not use in children less than 12 years of age.

FOR TREATMENT OF CHEST PAIN (ANGINA)

Nitroglycerin 1/150 grain (0.4 mg) or lingual aerosol (0.4 mg metered dose per spray). Adult dose 1 tablet dissolved under the tongue, or 1 spray under the tongue, for treatment of angina. This may be repeated every 10 minutes for two additional doses.

Side effects: dizziness (low blood pressure), headache. If a person uses nitroglycerin and becomes faint, he should lie down with his legs elevated until his skin color returns to normal and he feels better (usually, in a minute or two). If chest pain or weakness persists, this may indicate a heart attack (see page 50).

Nitroglycerin patch 0.4 to 0.6 mg. Apply for 12 to 24 hours.

Isorbide mononitrate or dinitrate (short acting formulation). Adult dose 20 to 60 mg by mouth twice daily.

Isorbide mononitrate or dinitrate (sustained release formulation). Adult dose 60 to 120 mg by mouth twice daily.

Side effects: headache, dizziness, nausea, irregular heartbeat (palpitations). This drug should not be given with medications for erectile dysfunction (e.g., sildenafil citrate [Viagra]).

Metoprolol (short-acting formulation). Adult dose 50 to 150 mg by mouth twice daily.

Metoprolol (sustained-release formulation). Adult dose 100 to 300 mg once daily.

Side effects: fatigue, shortness of breath, wheezing, weakness, dizziness.

Should be used with caution in persons with chronic obstructive pulmonary disease, diabetes, depression, severe peripheral vascular disease, certain abnormal heart rhythms, or erectile dysfunction.

Nifedipine (sustained-release formulation). 30 to 90 mg by mouth once daily.

Verapamil (short-acting formulation). 20 to 120 mg 2 to 3 times by mouth daily.

Verapamil (sustained-release formulation). 180 to 240 mg by mouth once or twice daily.

Diltiazem (sustained-release formulation). 120 to 480 mg by mouth once daily.

FOR TREATMENT OF CONGESTIVE HEART FAILURE

Furosemide (Lasix) diuretic (promotes urination). Adult dose 1 to 4 tablets (20 to 80 mg) each day for the fluid retention associated with heart failure. Diuretics should not be used for fluid retention not associated with heart failure (such as that from high altitude) or for weight reduction.

Digoxin (Lanoxin). Adult dose 0.125 to 0.25 mg each day.

FOR TREATMENT OF SEIZURES (EPILEPSY)

Diphenylhydantoin (Dilantin). Adult dose 300 to 400 mg per day; pediatric dose 2.5 mg/kg (2.2 lb) of body weight twice a day.

Phenobarbital. Adult dose 60 to 120 mg three times per day; pediatric dose 1 to 1.5 mg/kg (2.2 lb) of body weight three times a day.

Carbamazepine (Tegretol). Adult dose 400 to 1,200 mg a day in two to three divided doses; pediatric dose 10 to 20 mg/kg (2.2 lb) of body weight each day in two to three divided doses.

Levetiracetam (Keppra). Adult dose 500 to 1500 mg twice a day; pediatric dose 10 to 30 mg/kg (2.2 lb) of body weight twice a day.

FOR RELIEF FROM PAIN (SEE ALSO "FOR RELIEF FROM MUSCLE ACHES OR MINOR ARTHRITIS")

Acetylsalicylic acid (aspirin). Adult dose 325 to 1,000 mg every 4 to 6 hours (maximum dose 4,000 mg per day); pediatric dose 60 mg (1 grain) per year of age (not to exceed 600 mg) every 4 to 6 hours.

Side effect: stomach irritation. Do not administer to a person with an ulcer or upset stomach. Take with food or an antacid, if possible. Enteric-coated aspirin (such as Ecotrin) helps prevent stomach irritation and should be used whenever possible. To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.

Acetaminophen (Tylenol). Adult dose 500 to 1,000 mg every 4 to 6 hours (maximum dose 4,000 mg per day); pediatric dose: up to 1 year, 60 mg; 1 to 3 years, 60 to 120 mg; 3 to 6 years, 120 mg; 6 to 12 years, 240 mg.

Codeine. Adult dose 30 to 60 mg every 6 to 8 hours; pediatric dose 0.5 to 1 mg/kg (2.2 lb) of body weight.

Side effects: Codeine is a narcotic and has side effects of drowsiness and alteration of mental status. In addition, it may cause constipation.

Acetaminophen (Tylenol) 325 mg with codeine 30 mg. Adult dose 1 to 2 tablets every 4 to 6 hours.

Hydrocodone 5 mg with acetaminophen 500 mg (Vicodin). Adult dose 1 to 2 tablets every 4 to 6 hours. This is a narcotic drug and should not be taken in any situation where altered mental status will be dangerous.

Ketorolac (Toradol) 10 mg. Adult dose 1 tablet every 6 to 8 hours. This is an antiinflammatory drug that is particularly useful for persons suffering kidney stones.

FOR RELIEF FROM FEVER

Acetylsalicylic acid (aspirin). Same as “For Relief from Pain.” To avoid Reye syndrome (postviral encephalopathy and liver failure), do not use aspirin to control fever in a child under age 17.

Acetaminophen (Tylenol). Same as “For Relief from Pain.”

Ibuprofen (Motrin, Advil, Nuprin). Adult dose 400 to 600 mg every 4 to 6 hours; pediatric dose 5 to 10 mg/kg (2.2 lb) of body weight, not to exceed 400 mg.

FOR RELIEF FROM MUSCLE ACHES OR MINOR ARTHRITIS

Acetylsalicylic acid (aspirin). Same as “For Relief from Pain.”

Acetaminophen (Tylenol). Same as “For Relief from Pain.”

Nonsteroidal antiinflammatory drugs (“NSAIDs” should not be taken on an empty stomach; side effects are abdominal pain and diarrhea):

Ibuprofen (Motrin, Advil, Nuprin). Adult dose 400 to 800 mg every 6 to 8 hours.

Ketoprofen (Orudis KT, Actron). Adult dose 12.5 to 50 mg every 6 to 8 hours.

Naproxen (Naprosyn, Aleve). Adult dose 250 to 500 mg every 6 to 12 hours.

Naproxen sodium (Naprelan). Adult dose 375 or 500 mg sustained release every 24 hours.

Ketorolac (Toradol). Adult dose 10 mg every 8 to 12 hours; do not exceed 3 days' consecutive use.

Diclofenac/misoprostol (Arthrotec). Adult dose 50 to 75 mg (based on diclofenac) every 6 to 8 hours. This drug should not be given to women who are pregnant or who may become pregnant, because misoprostol may induce a miscarriage.

Celecoxib (Celebrex). Adult dose 10 to 200 mg twice a day. This is a COX-2 antagonist drug. *This drug is possibly associated with a higher incidence of heart attack in persons who use it.*

Metaxalone (Skelaxin). Adult dose 800 mg 3 or 4 times a day for relief from acute painful muscle spasms.

FOR RELIEF FROM MIGRAINE HEADACHE

Sumatriptan oral tablets. Adult dose 50 to 100 mg every 2 hours, not to exceed 200 mg/24 hours.

Sumatriptan nasal spray. Adult dose 5 or 20 mg every 2 hours, not to exceed 40 mg/24 hours.

Zolmitriptan oral tablets. Adult dose 2.5 to 5 mg every 2 hours, not to exceed 10 mg/24 hours.

Zolmitriptan "melting" tablets. Adult dose 2.5 mg to dissolve under the tongue every 2 hours, not to exceed 10 mg/24 hours.

Rizatriptan oral tablets. Adult dose 5 or 10 mg every 2 hours, not to exceed 30 mg/24 hours. If propranolol is also taken, use the 5 mg dose.

Almotriptan oral tablets. Adult dose 6.25 or 12.5 mg every 2 hours, not to exceed 25 mg/24 hours.

Naratriptan oral tablets. Adult dose 1 or 2.5 mg every 4 hours, not to exceed 5 mg/24 hours.

Frovatriptan oral tablets. Adult dose 2.5 mg every 4 hours, not to exceed 5 mg/24 hours.

Eletriptan oral tablets. Adult dose 20 or 40 mg every 2 hours, not to exceed 80 mg/24 hours.

FOR RELIEF FROM ITCHING

Diphenhydramine (Benadryl). Same as "For Relief from a Mild Allergic Reaction."

Hydroxyzine (Atarax). Adult dose 25 to 50 mg every 8 hours; pediatric dose: up to 6 years, 10 mg every 8 hours; 6 to 12 years, 10 to 25 mg every 8 hours.

FOR RELIEF FROM TOOTHACHE

Benzocaine-phenol-alcohol (Anbesol). For topical application to the gums.

Oil of cloves. For topical application to the gums.

FOR RELIEF FROM MOTION SICKNESS

Dimenhydrinate (Dramamine). Adult dose 50 mg every 4 to 6 hours; pediatric dose (8 to 12 years of age) 25 mg every 4 to 6 hours.

Side effect: drowsiness.

Meclizine (Antivert, Bonine). Adult dose 25 to 50 mg one to two times per day. Do not give this drug to children under age 12.

Side effect: drowsiness.

- *Cyclizine (Marezine).* Adult dose 25 mg; pediatric dose 12.5 mg for ages 9 to 12.
- *Scopolamine (Transderm-Scōp Transdermal Therapeutic System).* Adult dose: Apply 1 patch (1.5 mg scopolamine) on the hairless area behind the ear. A single patch is good for 3 days. Take care to wash the hands carefully after

application of the patch, to avoid getting any medication in the eyes. Not approved for children under age 12.

Side effects: blurred vision, dry mouth, decreased sweating, difficulty with urination, propensity to heat illness, altered mental status. A diver who uses this preparation should be alert to the danger of heat illness while out of the water encased in a constrictive (heat-retaining) wet suit.

FOR RELIEF FROM NAUSEA AND VOMITING

Ondansetron (Zofran). Adult dose 4 or 8 mg tablet dissolved on the tongue every 8 hours; pediatric dose 0.15 mg/kg body weight of the oral dissolving tablet every 8 hours. This drug is also indicated for nausea and vomiting after surgery or associated with chemotherapy. It appears to be safe in children and in the elderly.

Prochlorperazine (Compazine). Adult dose 5 to 10 mg by mouth every 8 to 12 hours (by suppository 25 mg twice daily). Do not give this drug to children under age 12.

Side effects: neck spasms, difficulty in swallowing and talking (inability to control the tongue), restlessness, difficulty with eye movement, and muscle stiffness. These side effects may occur in combination ("dystonic reaction"). If any of these occur, discontinue use of the drug and administer diphenhydramine (Benadryl) 50 mg every 6 hours for four doses. If a child has a dystonic reaction, the dose of diphenhydramine (Benadryl) to alleviate the side effects is 1 mg/kg (2.2 lb) of body weight. Be certain that the victim is capable of purposeful swallowing.

Promethazine (Phenergan). Adult dose 25 mg every 6 to 8 hours (by suppository 12.5 to 25 mg every 12 hours); pediatric dose 0.25 to 0.5 mg/kg (2.2 lb) of body weight by mouth or per rectum (suppository).

Side effects: similar to those with prochlorperazine.

Trimethobenzamide (Tigan). Adult dose 250 mg by mouth or 200 mg by suppository every 6 to 8 hours.

Side effects: similar to those with prochlorperazine.

Cyclizine hydrochloride (Marezine). Adult dose 25 to 50 mg every 6 to 8 hours.

FOR RELIEF FROM DIARRHEA

Loperamide (Imodium or Pepto Diarrhea Control caplets). Adult dose 2 pills (2 mg each) initially, followed by 1 pill after each loose bowel movement, not to exceed 8 pills. With uncomplicated (no fever or blood in stools) watery diarrhea, this drug can be given to children age 2 years and older. The dose

in children is 0.2 mg/kg (2.2 lb) of body weight every 6 hours. The liquid preparation contains 1 mg per 5 tsp (5 mL).

Diphenoxylate (Lomotil). Adult dose 2 tablets two to four times per day. Do not give this drug to children under age 18.

Bismuth subsalicylate (Pepto-Bismol). Adult dose 2 tbsp (30 mL) or 2 tablets every 30 to 60 minutes, not to exceed 8 to 10 doses; pediatric dose: 3 to 6 years, 1 tsp (5 mL) or ½ tablet; 6 to 10 years, 2 tsp (10 mL) or 1 tablet; 10 to 14 years, 4 tsp (20 mL) or 1½ tablets; may repeat dose in children every 1 hour, not to exceed four doses. This drug should not be given to people who are sensitive to aspirin-containing products, have kidney disease or gout, or who are taking anticoagulants, probenecid, or methotrexate.

Side effects: black discoloration of the tongue and bowel movements, ringing in the ears, nausea, and constipation.

Kaolin-pectin (Kaopectate). Adult dose 4 to 8 tbsp (60 to 120 mL) after each loose bowel movement; pediatric dose: 3 to 6 years, 1 to 2 tbsp (15 to 30 mL); 6 to 12 years, 2 to 4 tbsp (30 to 60 mL); older than 12 years, 4 tbsp (60 mL) after each loose bowel movement. This drug is of limited value; it does not shorten the course of diarrheal illness, and acts only to add a little consistency to stools.

FOR RELIEF FROM CONSTIPATION

Mineral oil. Adult dose 1 to 2 tbsp (15 to 30 mL); pediatric (older than 5 years) dose 1 to 2 tsp (5 to 10 mL). This drug is a mild laxative.

Docusate sodium (Colace). Adult dose 100 mg twice a day; pediatric dose 0.3 mg/kg (2.2 lb) of body weight once or twice a day. The dose should be adjusted to the response. This drug is a stool softener.

Docusate sodium (stool softener) with casanthranol (laxative) (Peri-Colace). Adult dose 1 capsule once or twice a day.

Docusate sodium (stool softener) 5 mL microenema. Adult dose 200 mg (one enema) once a day as necessary.

Docusate calcium (stool softener) (Surfak Stool Softener Gel Cap). Adult dose 240 mg once or twice a day.

Senna extract (Senokot). Two tablets a day at bedtime. This drug is a mild laxative.

Magnesium hydroxide (Phillips' Milk of Magnesia). Adult dose 1 to 2 tbsp (15 to 30 mL) once or twice a day. This drug is a mild laxative.

Magnesium citrate (Evac-Q-Mag). Adult dose 10 to 20 tbsp (150 to 300 mL) as needed.

Lactulose syrup, USP (Duphalac). Adult dose 1 to 2 tbsp (15 to 30 mL) daily. This drug is a mild laxative.

Bisacodyl (Dulcolax). Adult dose two 5 mg tablets or one 10 mg suppository. This drug is a moderate laxative. A child age 6 to 12 years may take one 5 mg tablet.

Cascara sagrada 150 mg; aloe 100 mg (Nature's Remedy) (laxative). Adult dose 2 tablets a day.

Psyllium mucilloid (*Metamucil*, *Perdiem*, *Fiberall*). Adult dose titrate up to 20 grams per day. These natural psyllium fiber products increase the bulk of the stool, and should be ingested with at least a quart (liter) of liquid.

Methylcellulose (*Citrucel*). Adult dose titrate up to 20 grams per day.

Polycarbophil (*Fibercon*, *Equalactin*, *Konsyl*). Adult dose titrate up to 20 grams per day.

Lactulose. 10 mg/15 mL of syrup. Adult dose 15 to 30 mL per day, up to 60 mL per day.

Polyethylene glycol solution (*MiraLax*). 17 g powder (1 heaping tbsp) dissolved in 8 oz (240 mL) water, taken once per day for up to 4 days to produce a bowel movement.

FOR RELIEF FROM ULCER PAIN

Mylanta II. Adult dose 2 tbsp (30 mL) or 2 tablets (chewed) 1 and 3 hours after meals, at bedtime, and as needed. This is a mixture of aluminum hydroxide, magnesium hydroxide, and simethicone.

Roloids. Adult dose 1 to 2 tablets (chewed) after meals as necessary. These contain dihydroxy-aluminum sodium carbonate. Because of the relatively high sodium content, these should not be used routinely by people with congestive heart failure (see page 47).

Cimetidine (*Tagamet*). Adult dose 300 mg three times a day with meals and at bedtime. This H₂RA (antagonist to histamine H₂ receptor) drug decreases the secretion of gastric acid.

Ranitidine hydrochloride (*Zantac*). Adult dose 75 to 150 mg two times a day. This H₂RA drug decreases the secretion of gastric acid.

Famotidine (*Pepcid*). Adult dose 20 mg twice a day or 40 mg at bedtime for 4 weeks to treat an active duodenal ulcer, then 20 mg at bedtime for 2 to 4 weeks for suppression therapy to diminish the secretion of gastric acid. This H₂RA drug decreases the secretion of gastric acid.

Propantheline bromide (*Pro-Banthine*). Adult dose 7.5 to 15 mg three times a day before meals and at bedtime. This drug is used to control gastric acid secretion and to reduce bowel activity (decrease cramping).

Sucralfate (*Carafate*). Adult dose 1 tablet (gram) 1 hour before meals and at bedtime. This drug binds to the ulcer crater, and therefore requires the presence of acid to work properly. Thus, antacids should not be ingested within 30 minutes before or after the ingestion of sucralfate.

Omeprazole (*Prilosec*). Adult dose 1 capsule (20 mg) a day given 30 minutes before a meal. This PPI (proton [acid] pump inhibitor) drug diminishes gastric acid secretion.

FOR RELIEF FROM INDIGESTION OR GAS PAINS

Antacid (such as *Mylanta II*). Same as “For Relief from Ulcer Pain.”

Simethicone (*Mylicon-80*). Adult dose 1 to 2 tablets (chewed) after meals and at bedtime.

FOR RELIEF FROM HEARTBURN (REFLUX ESOPHAGITIS)

Omeprazol (Prilosec). Adult dose 10 to 20 mg once a day.

Antacid (such as Mylanta II). Same as "For Relief from Ulcer Pain."

Ranitidine hydrochloride (Zantac). Adult dose 75 mg every 12 hours as needed.

This H₂RA (antagonist to histamine H₂ receptor) drug decreases the secretion of gastric acid.

Cimetidine (Tagamet HB). Adult dose 200 mg (two 100 mg tablets) 30 to 60 minutes before a meal, not to exceed twice in a 24-hour period. This H₂RA drug decreases the secretion of gastric acid.

Famotidine (Pepcid AC). Adult dose 10 to 20 mg as 10 mg chewable tablet or gelcap twice a day for up to 6 weeks.

Gaviscon or Gaviscon II. Adult dose 1 to 2 tablets (chewed) or 1 to 2 tbsp (15 to 30 mL) (liquid preparation) after each meal and at bedtime. This is a mixture of aluminum hydroxide, magnesium trisilicate, sodium bicarbonate, and alginic acid.

Metoclopramide hydrochloride (Reglan). Adult dose 10 mg up to four times a day, 30 minutes before meals and at bedtime.

Side effects: rarely, neck spasms, difficulty in swallowing and talking (inability to control the tongue), difficulty with eye movement, and muscle stiffness. These side effects may occur in combination ("dystonic reaction"). If any of these occur, discontinue use of the drug and administer diphenhydramine (Benadryl) 50 mg every 6 hours for four doses. Be certain that the victim is capable of purposeful swallowing.

FOR RELIEF FROM NASAL CONGESTION

Pseudoephedrine (Sudafed). Adult dose 30 to 60 mg every 6 to 8 hours; pediatric dose 1 mg/kg (2.2 lb) of body weight. **THE U.S. FDA RECOMMENDS THAT THIS DRUG NOT BE USED IN CHILDREN UNDER 6 YEARS OF AGE.**

Phenylephrine hydrochloride 0.25% nasal spray (Neo-Synephrine ¼%). Adult dose 2 to 3 drops or sprays twice a day; pediatric dose (older than 6 years) 0.125% two drops twice a day. Do not use this drug for more than 3 consecutive days, to avoid "rebound" swelling of the nasal passages from chemical irritation and sensitization to the medicine.

Oxymetazoline hydrochloride 0.05% (Afrin). Adult dose 2 to 3 drops or sprays twice a day; pediatric dose (older than 6 years) two 0.025% (half-strength) drops twice a day. Do not use this drug for more than 3 consecutive days, to avoid "rebound" swelling of the nasal passages from chemical irritation and sensitization to the medicine.

FOR RELIEF FROM COUGH

A U.S. FOOD AND DRUG ADMINISTRATION ADVISORY PANEL IN 2007 RECOMMENDED THAT THERE IS NO EVIDENCE THAT OVER-THE-COUNTER COLD AND COUGH MEDICINES WORK IN CHILDREN AND THAT THE PRODUCTS SHOULD NOT BE GIVEN TO CHILDREN YOUNGER THAN 6 YEARS OF AGE.

Glyceryl guaiacolate (Robitussin) expectorant. Adult dose 1 tsp (5 mL) every 3 to 4 hours.

Robitussin A-C: plus codeine (cough suppressant).

Robitussin-DAC: plus codeine, pseudoephedrine (decongestant).

Robitussin-PE: plus pseudoephedrine.

Robitussin-DM: plus dextromethorphan (cough suppressant).

Codeine. Adult dose 15 to 30 mg every 4 to 6 hours. This is a potent cough suppressant.

CoTylenol Liquid Cold Formula. Adult dose 2 tbsp (30 mL) every 6 hours. Two tbsp (30 mL) contains dextromethorphan hydrobromide 30 mg (for cough), acetaminophen 650 mg (for fever, aches), chlorpheniramine maleate (antihistamine) 4 mg, and pseudoephedrine hydrochloride (decongestant) 60 mg.

Dextromethorphan hydrobromide–guaifenesin (Vicks Cough Syrup). Adult dose 2 to 3 tsp (10 to 15 mL) every 4 to 6 hours.

Dextromethorphan hydrobromide–guaifenesin–phenylpropanolamine (Naldecon cough syrup). Adult dose 1 tsp (5 mL) every 4 hours.

Buckwheat honey. Dose one to two teaspoons for children ages 2 to 18 years. *It is not advised to feed honey to infants or children younger than 12 months of age because of the risk for infant botulism.*

Mucinex (guaifenesin 600 mg). This drug is taken every 12 hours and works to help loosen phlegm (mucus) and thin bronchial secretions to rid the bronchial passageways of bothersome mucus and make coughs more productive.

FOR RELIEF FROM SORE THROAT

Benzocaine-hexylresorcinol (Sucrets antiseptic throat lozenges).

Benzocaine-cetylpyridinium (Cēpacol lozenges, Vicks lozenges).

COLD FORMULAS

A U.S. FOOD AND DRUG ADMINISTRATION ADVISORY PANEL IN 2007 RECOMMENDED THAT THERE IS NO EVIDENCE THAT OVER-THE-COUNTER COLD AND COUGH MEDICINES WORK IN CHILDREN AND THAT THE PRODUCTS SHOULD **NOT BE GIVEN TO CHILDREN YOUNGER THAN 6 YEARS OF AGE.**

Contac. Phenylpropanolamine (decongestant), chlorpheniramine (antihistamine).
Contac Severe Cold Formula. Pseudoephedrine (decongestant), chlorpheniramine, acetaminophen (for fever, aches), dextromethorphan (for cough).
Chlor-Trimeton. Chlorpheniramine.
Chlor-Trimeton Decongestant. Chlorpheniramine, pseudoephedrine.
Coricidin. Chlorpheniramine, aspirin.
Coricidin D. Phenylpropanolamine, chlorpheniramine, aspirin.
CoAdvil. Ibuprofen (for fever, aches), pseudoephedrine.
CoTylenol. See “For Relief from Cough.”
Dristan. Phenylephrine (decongestant), chlorpheniramine, aspirin, caffeine.
Dristan Time Capsule. Phenylephrine, chlorpheniramine.
TheraFlu. Acetaminophen, pseudoephedrine, chlorpheniramine.

SKIN MEDICATIONS

Antiseptic Ointments, Solutions, and Scrubs

Apply ointments thinly to the skin twice a day.

Bacitracin antiseptic ointment.
Bacitracin–polymyxin B sulfate (Polysporin) ointment.
Mupirocin (Bactroban) 2% ointment.
Mupirocin (Bactroban) calcium 2% cream.
Bacitracin–polymyxin B sulfate–neomycin (Neosporin, Triple Antibiotic, or Mycitracin) ointment.
Neomycin–gramicidin (Spectrocin) ointment.
Neomycin (Myciguent) ointment.
Retapamulin 1% (Altabax) ointment.
Povidone iodine 0.5% (Betadine First Aid) cream.
Silver sulfadiazine (Silvadene) cream. Soothing antiseptic cream for burns; apply to the skin once or twice a day. Do not use in children younger than 2 years. Avoid use on the face.
Benzalkonium chloride (Zephiran) antiseptic solution (1:750 dilution in water). May be used full strength to clean unbroken skin, but should be diluted 1:2 or 1:3 with water to swab an open wound or animal bite (to kill rabies virus).
Hexachlorophene scrub (pHisoHex). Use as a scrubbing soap on cuts, scrapes, and infected skin. Do not use on children under 1 year of age.
Povidone iodine (Betadine) antiseptic solution. Use in a 1:10 dilution with water to gently scrub cuts and scrapes.

Anti-Itch, Anti-Sting

Campho-Phenique. Topical anti-itch gel medication consisting of camphorated phenol in mineral oil.

Campho-Phenique Maximum Strength ointment or Neosporin Plus ointment or Mycitracin Plus ointment. Topical anti-itch and antiseptic medication consisting of lidocaine hydrochloride, bacitracin zinc, neomycin sulfate, and polymyxin B sulfate.

Lidocaine hydrochloride 2.5% anesthetic ointment. Use for relief from pain due to scrapes; apply to the skin and leave in place for 10 minutes before scrubbing. Do not apply if the area to be covered is greater than 5% of the total body surface area (an area approximately four to five times the size of the victim's palm).

Benzalkonium chloride 0.13%; lidocaine hydrochloride 2.5% (Bactine solution). Very mild antiseptic-anesthetic combination available over the counter. May be used to swab animal bites if Zephiran is not available.

Calamine lotion. Apply thinly as a drying agent two to three times a day to skin affected with poison ivy, oak, or sumac.

Phenolated (1%) calamine lotion. Apply thinly as a drying agent two to three times a day to skin affected with poison ivy, oak, or sumac.

Calamine-pramoxine hydrochloride 1% (Caladryl). Apply thinly as a drying agent two to three times a day to skin affected with poison ivy, oak, or sumac.

Hydrocortisone and pramoxine (Pramosone). Topical anti-itch medication for skin rashes due to plant allergy, insect bites, or sunburn. Apply two to three times a day.

Antifungal Cream, Lotion, Pill, Spray and Powder

Apply to the skin two to three times a day for athlete's foot or jock itch.

Tolnaftate 1% (Tinactin, Aftate).

Terbinafine 1% cream or spray (Lamisil).

Clotrimazole 1% (Lotrimin, Mycelex).

Zinc undecylenate (Desenex).

Miconazole nitrate 2% (Micatin).

Nizoral cream. Apply thinly once or twice a day to treat yeast or fungal infection.

Nizoral. 400 mg one oral dose for tinea versicolor (harmless yeast overgrowth on the skin); induce mild sweating 2 to 4 hours after dose; don't shower for 8 hours after dose (the drug is excreted in sweat).

Spectizole cream. Apply thinly once or twice a day to treat yeast or fungal infection.

Anti-Mites

Permethrin 5% cream (Elimite). Apply to entire skin, leave on for 8 hours, and then shower for treatment of scabies; appears to be safe in pregnant women and children over 2 months of age.

Permethrin 1% creme rinse (Nix). Apply to washed and towel-dried hair, leave on for 10 minutes, and then rinse thoroughly and comb out nits for treatment of head lice.

Malathion (Ovide). Apply to dry hair, leave on without occlusion for 8 to 12 hours, and then shampoo and rinse thoroughly and comb out nits for treatment of head lice.

Crotamiton (Eurax). For topical use only. To treat scabies, take a bath or shower. Apply the medication over the whole body from the chin down. Rub in gently, paying special attention to skin folds and creases. Trim fingernails and apply the medication under the nails. Change all clothing and bed linens the next morning and wash them in the hot cycle of the washing machine. A second application of the medication should be done in 24 hours. Take a good cleaning bath or shower 48 hours after the last application. To relieve dry skin, apply a small amount of the medication to the affected area and rub it in gently until it disappears. Avoid use on open, irritated, or inflamed skin. Avoid use near the eyes, mouth, or vagina.

Topical Steroids

Hydrocortisone 1% cream, 2.5% cream (Hytone). Safe for infants, face, perianal area, skin folds.

Triamcinolone 0.1% ointment. Often mixed with Eucerin cream 1:1; moisturizer increases penetration—too potent for face, genitalia, or infants.

FOR SLEEP

Diphenhydramine (Benadryl, Sominex, Nytol). Adult dose 50 mg at bedtime.

Triazolam (Halcion). Adult dose 0.125 to 0.25 mg at bedtime. This is short-acting and may be a better choice at high altitude.

Side effects: short-term memory loss, bad dreams.

Zolpidem tartrate (Ambien). Adult dose 5 to 10 mg, or 6.25 mg or 12.5 mg extended release, at bedtime. There have been rare reports of hallucinations in people who took higher doses; elders may be prone to such a reaction.

Zaleplon (Sonata). Adult dose 10 mg at bedtime. The dose is 5 mg for elderly, debilitated, or liver-impaired adults.

Eszopiclone (Lunesta). Adult dose 1, 2, or 3 mg at bedtime.

Ramelteon (Rozerem). Adult dose 8 mg at bedtime.

Temazepam (Restoril). Adult dose 15 to 30 mg at bedtime.

Flurazepam (Dalmane). Adult dose 15 to 30 mg at bedtime.

Melatonin. The hormone melatonin is endogenously produced by humans in the pineal gland from the precursor tryptophan. Melatonin levels in the blood increase and are highest during normal hours of sleep, decreasing toward morning.

Sold over the counter, melatonin is considered a “dietary supplement,” and thus does not come under the scrutiny of the Food and Drug Administration.

The science supporting its use to induce sleep, decrease wakefulness during sleep, and decrease jet lag is preliminary and suggests that it might be beneficial, without any obvious adverse effects. The doses cited range from 1 mg to 5 mg administered orally 1 to 2 hours before going to bed.

ANTIBIOTICS

Amoxicillin. Adult dose 250 to 500 mg every 8 hours; pediatric dose 10 to 15 mg/kg (2.2 lb) of body weight every 8 hours (three times a day).

Amoxicillin-clavulanate (Augmentin). Adult dose 500 to 875 mg two times a day; pediatric dose 25 to 45 mg/kg (2.2 lb) of body weight in two divided doses per day. For otitis media in children, use the higher dose.

Ampicillin. Same dose as phenoxymethyl penicillin (see below).

Azithromycin (Zithromax). Adult dose 500 mg day 1, then 250 mg per day for 4 additional days; pediatric dose 10 mg/kg (2.2 lb) of body weight day 1, then 5 mg/kg body weight for 4 additional days.

Cefadroxil (Duricef). Adult dose 500 mg to 1 g twice a day. For pharyngitis, to eradicate the group A streptococcus, an acceptable dose is 1 g once a day for 10 days. Pediatric dose: for skin infections, 30 mg/kg (2.2 lb) of body weight per day in two divided doses; for pharyngitis, administer in a single dose or two divided doses for 10 days.

Cefdinir. Adult dose 300 mg twice per day; pediatric dose 7 mg/kg (2.2 lb) of body weight twice per day.

Cefixime. Adult dose 400 mg per day; pediatric dose 8 mg/kg (2.2 lb) of body weight once per day; no refrigeration needed—discard 14 days after the dry powder is reconstituted with water.

Cefuroxime axetil. Adult dose 500 mg twice a day; pediatric dose 30 mg/kg (2.2 lb) of body weight in two divided doses a day.

Cefpodoxime (Vantin). Adult dose 200 to 400 mg twice a day for pneumonia.

Cefprozil (Cefzil). Adult dose 500 g once a day; pediatric dose 7.5 to 15 mg/kg (2.2 lb) of body weight twice per day.

Cephalexin (Keflex). Adult dose 250 mg every 4 to 6 hours or 500 mg every 12 hours; pediatric dose the same as for phenoxymethyl penicillin. *Avoid use* in a person with penicillin allergy, because 5% to 10% of those allergic to penicillin are also allergic to cephalosporins.

Ciprofloxacin (Cipro). Adult dose 500 mg twice a day for 3 days to treat infectious diarrhea. This drug should not be given to pregnant women or children under age 18. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Clarithromycin (Biaxin). Adult dose 500 mg twice a day; pediatric dose 15 mg/kg (2.2 lb) of body weight in two divided doses per day.

Clindamycin (Cleocin). Adult dose 300 mg three times a day; pediatric dose 30 mg/kg (2.2 lb) of body weight in three or four divided doses per day.

Dicloxacillin. Same dose as phenoxymethyl penicillin (below).

Doxycycline (Vibramycin). Adult dose 100 mg twice a day for treatment, or once a day for prevention, of infectious diarrhea. Do not give to pregnant women or children up to age 7 years, because this drug may cause permanent dark discoloration of the teeth. Children above age 7 years may take 2 to 4 mg/kg (2.2 lb) of body weight in two or four divided doses.

Erythromycin. Same dose as phenoxymethyl penicillin (see below). Common side effects are stomach upset and diarrhea. This drug is the first alternative to penicillin in penicillin-allergic individuals. *This drug should not be taken in combination with nitroimidazole antifungal agents (ketoconazole, itraconazole, fluconazole), diltiazem, verapamil, or troleandomycin because of a potential interaction that might cause a serious abnormal heart rhythm associated with sudden death.*

Fleroxacin. Adult dose 400 mg once a day for 3 days for the treatment of infectious diarrhea. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Levofloxacin. Adult dose 250 to 500 mg once a day. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Linezolid (Zyvox). Adult dose 400 to 600 mg twice a day for MRSA infection; pediatric dose 30 mg/kg (2.2 lb) of body weight in three divided doses.

Metronidazole (Flagyl). Adult dose 250 mg three times a day. *Do not drink alcohol when taking this medication and for 3 days afterward; the interaction would cause severe abdominal pain, nausea, and vomiting.*

Noroxin. Adult dose 400 mg every 12 hours. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Ofloxacin. Adult dose 300 to 400 mg every 12 hours. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Phenoxymethyl penicillin (Penicillin VK). Adult dose 250 to 500 mg every 4 to 6 hours; pediatric dose: 2 to 6 years, 125 mg every 6 to 8 hours; 6 to 10 years, 250 mg every 6 to 8 hours. For pharyngitis, to eradicate the group A streptococcus, an acceptable adult dose is 1 g twice a day for 10 days. Swelling of the lips, eyes, and mucous membranes occurs in about 1 per 10,000 courses of penicillin.

Rifampin (Rifadin). Adult and pediatric dose 20 mg/kg (2.2 lb) of body weight per day in two or four divided doses, not to exceed 600 mg per day.

Rifaximin. Adult dose 200 mg three times a day for traveler's diarrhea.

Sparfloxacin (Zagam). Adult dose 400 mg day 1, then 200 mg each day. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

Sulfisoxazole (Gantrisin). Pediatric dose 150 mg/kg (2.2 lb) of body weight in four to six divided doses a day, not to exceed 6 gm per day.

Telithromycin (Ketek). Adult dose 800 mg once a day.

Tetracycline. Adult dose 500 mg four times a day. Do not give to pregnant women or children up to age 7, because this drug may cause permanent dark discoloration of the teeth.

Tinidazol (Tiniba, Fasgyn). Adult dose 2 g in a single dose; pediatric dose 50 mg/kg (2.2 lb) of body weight in a single dose

Trimethoprim-sulfamethoxazole (Bactrim or Septra DS [double strength]). Adult dose 1 pill (80 mg trimethoprim with 400 mg sulfamethoxazole) twice a day for infectious diarrhea or bladder infection; 1 pill once a day for prevention of traveler's diarrhea. The pediatric dose for an ear infection, MRSA infection, or severe infectious diarrhea (caused by *Shigella* bacteria) is 1 tsp (5 mL) of the pediatric suspension per 10 kg (22 lb) of body weight every 12 hours (twice a day), not to exceed 4 tsp (20 mL) (the adult dose) per dose. More precisely, the pediatric dose is 4 mg/kg/dose trimethoprim (TMP) with 20 mg/kg/dose sulfamethoxazole (SMX).

Trovafloracin (Trovan). Adult dose 200 mg once a day for 10 days to treat acute sinusitis. *This drug should not be administered to someone with myasthenia gravis, because of the possibility of a prolonged myasthenic crisis.*

APPENDIX TWO: CONVERSION TABLES

FAHRENHEIT/CENTIGRADE (CELSIUS) TEMPERATURE CONVERSION

To convert degrees Fahrenheit (°F) into degrees Centigrade (°C, or Celsius), subtract 32, then multiply by 5, then divide by 9. To convert degrees C into degrees F, multiply by 9, then divide by 5, then add 32. For extrapolation into “subzero” (below 0°F) range, be aware that 1 Fahrenheit degree represents the temperature change of $\frac{5}{9}$ of a Centigrade degree, or 1 Centigrade degree represents 1.8 times the temperature change of a Fahrenheit degree. For example, to obtain the Centigrade number equivalent to 0°F, subtract 32 from 0° (which yields -32), then multiply by $\frac{5}{9}$, which yields -17.8 Centigrade. However, recall that when most people use the phrase *17 below*, they are referring to below 0 on the Fahrenheit scale.

Degrees Centigrade	Degrees Fahrenheit
-17.8	0
-17	1.4
-16	3.2
-15	5.0
-14	6.8
-13	8.6
-12	10.4
-11	12.2
-10	14.0
-9	15.8
-8	17.6
-7	19.4
-6	21.2
-5	23.0
-4	24.8
-3	26.6
-2	28.4
-1	30.2
0	32.0
1	33.8
2	35.6
3	37.4
4	39.2
5	41.0
6	42.8
7	44.6
8	46.4
9	48.2
10	50.0
11	52.0
12	53.6
13	55.4
14	57.2

Degrees Centigrade	Degrees Fahrenheit
15	59.0
16	60.8
17	62.6
18	64.4
19	66.2
20	68.0
21	69.8
22	71.6
23	73.4
24	75.2
25	77.0
26	78.8
27	80.6
28	82.4
29	84.2
30	86.0
31	87.8
32	89.6
33	91.4
34	93.2
35	95.0
36	96.8
37	98.6
38	100.4
39	102.2
40	104.0
41	105.8
42	107.6
43	110.0
44	111.2
45	113.0
46	114.8

Continued

Degrees Centigrade	Degrees Fahrenheit
47	116.6
48	118.4
49	120.2
50	122.0
100	212.0

MEASURES OF LENGTH

Unit	U.S. Equivalent	Metric Equivalent
inch	1 in	0.0254 m; 2.54 cm
foot	12 in; .333 yd	0.3048 m; 30.48 cm
yard	3 ft; 36 in	0.914 m
fathom	6 ft; 72 in	1.83 m
rod	16.5 ft; 5.5 yd	5.029 m
mile	5,280 ft; 1,760 yd	1,608.64 m; 1.609 km
millimeter	0.03937 in	0.001 m
centimeter	0.3937 in	0.01 m
decimeter	3.937 in	0.1 m
meter	39.37 in; 3.28 ft	1 m
decameter	10.93 yd	10 m
hectometer	328.08 ft; 109.36 yd	100 m
kilometer	0.6214 miles	1,000 m

MEASURES OF VOLUME (CAPACITY)

Unit	U.S. Equivalent	Metric Equivalent
minim	$\frac{1}{60}$ fluidram	0.061610 mL
drop	0.017 fluid oz	0.5 mL
fluidram	60 minims	3.696 mL
teaspoon	0.170 fl oz	5 mL
tablespoon	3 tsp; 0.51 fl oz	15 mL
fluid ounce	8 fluidrams	29.573 mL
gill	4 fl oz	118.291 mL
cup	8 fl oz; 16 tbsp	236.58 mL

Unit	U.S. Equivalent	Metric Equivalent
pint	2 cups	0.473 liter
quart	2 pints; $\frac{1}{4}$ gallon	0.946 liter
gallon	4 quarts	3.785 liters
barrel	31.5 gallons	119.23 liters
hogshead	2 barrels; 63 gallons	238.46 liters
milliliter	0.034 fl oz	0.001 liter
centiliter	0.338 fl oz	0.01 liter
deciliter	3.38 fl oz	0.1 liter
liter	1.05 quarts	1 liter; 1,000 mL
kiloliter	1,050 quarts; 262.5 gallons	1,000 liters

MEASURES OF WEIGHT

Unit	U.S. Equivalent	Metric Equivalent
grain	0.002083 oz (apothecary)	0.0648 g; 64.8 mg
gram	0.04 oz; 0.002 lb	1 g
ounce (avoirdupois)	437 grains	28.349 g
pound (avoirdupois)	16 oz; 7,000 grains	0.453 kg; 454 g
ton (short)	2,000 lb	0.907 metric ton

CONVERSION BETWEEN FEET AND METERS

Feet to Meters

Feet	Meters
1	0.30
10	3.05
100	30.48
1,000	301
2,000	608
3,000	914
4,000	1,219
5,000	1,524
6,000	1,829

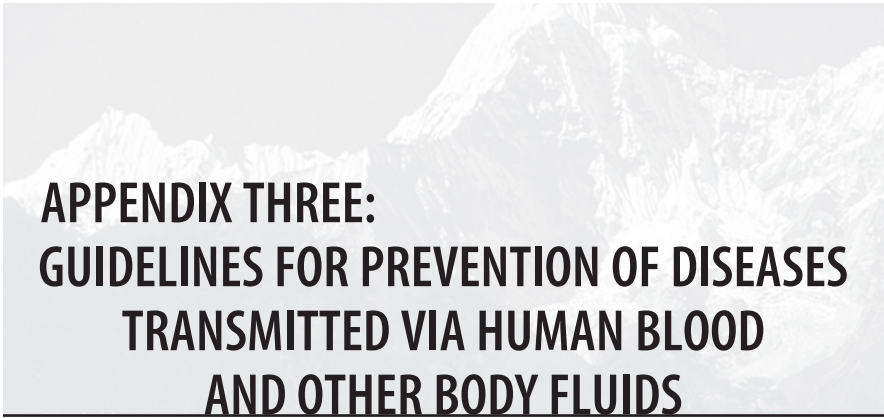
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Feet	Meters
7,000	2,134
8,000	2,438
9,000	2,743
10,000	3,048
11,000	3,353
12,000	3,658
13,000	3,962
14,000	4,267
15,000	4,572
16,000	4,877
17,000	5,182
18,000	5,486
19,000	5,791
20,000	6,096
21,000	6,401
22,000	6,705
23,000	7,010
24,000	7,315
25,000	7,620
26,000	7,925
27,000	8,230
28,000	8,534
29,000	8,939

Meters to Feet

Meters	Feet
1	3.28
10	33
100	330
1,000	3,281
2,000	6,562
3,000	9,842

Meters	Feet
4,000	13,123
5,000	16,404
6,000	19,685
7,000	22,966
8,000	26,247
9,000	29,528



APPENDIX THREE: GUIDELINES FOR PREVENTION OF DISEASES TRANSMITTED VIA HUMAN BLOOD AND OTHER BODY FLUIDS

Human fluids commonly encountered by laypeople during medical or recreational activities that would be considered high risk for the transmission of disease include blood, semen, vaginal secretions, saliva, and any fluid contaminated by blood, feces, and urine. Not all fluids are of equal risk, depending on the infectious agent. For instance, feces, nasal secretions, respiratory secretions, sweat, tears, urine, and vomitus do not appear to appreciably transmit the human immunodeficiency virus (HIV), but it is usually very difficult to tell if these fluids are contaminated with blood. Therefore, it is safest to assume that any body fluid can transmit disease, and to avoid unprotected contact with any moist human body substance.

To minimize the transmission of infectious disease, a medical rescuer should take the following precautions:

- Be careful with sharp objects, such as knives and needles. Obtain all available useful immunizations (including hepatitis; see page 454).

- Use personal protective equipment, such as disposable latex or hypoallergenic gloves, goggles (eyeshields, glasses, ski goggles), pocket mask or barrier shield (for rescue breathing), and gown or overclothing. In cold weather, thin glove liners can be worn under disposable gloves.
- After any victim contact, even if gloves are worn, wash your hands thoroughly with soap and water. If a glove breaks during contact with a victim, remove it and wash your hands immediately.
- Unbroken skin is very protective. However, if broken or unbroken skin is exposed to a victim's body fluid, it should be washed immediately with soap and water. If soap and water are not available, use waterless antiseptic hand cleanser, plain water, or snow.
- Carry materials contaminated by body fluids in clearly labeled nonpermeable containers, such as heavy plastic bags. Carry "sharps" (e.g., used needles) in impenetrable containers.
- If equipment (such as a litter) has been contaminated by a body fluid and must be reused, it should be cleaned by washing with soap and water, and then scrubbing with a minimum 1:10 dilution of household bleach (sodium hypochlorite) in water. Alternative minimum dilutions (in water) for disinfection include 0.3% hydrogen peroxide, 25% ethyl alcohol, 35% isopropyl alcohol, 0.5% Lysol, and 0.25% povidone iodine (Betadine). Wear gloves while cleaning the equipment. Eyeglasses can be washed with soap and water.

The purpose of educating you about precautions is not to discourage you from helping another in need. Rather, it is to support the notion that with just a moment of thought and the initiation of proper precautions, needless transmission of infectious diseases can be prevented, and a medical rescue can proceed without harm to the rescuer.

GLOSSARY

abdomen:	the part of the body between the chest and the pelvis
abrasion:	a scraped area of skin
abscess:	a localized collection of pus, usually surrounded by inflamed tissue
acclimatize:	to adapt to a new altitude, climate, environment, or situation
acidotic:	in a state of abnormally reduced alkalinity; overwhelmed by acid; related to decreased pH
acute:	sudden in onset
adrenaline:	epinephrine
airway:	passage for air into the lungs, including the mouth, nose, pharynx, larynx, trachea, and bronchi
alkaline:	having the properties of a base; related to high pH
allergy:	exaggerated reaction (sneezing, runny nose, itching, skin rash, difficulty in breathing) to substances that do not affect other individuals
alveoli:	microscopic air spaces in the lung where oxygen is exchanged for carbon dioxide
ambulatory:	able to walk
amnesia:	loss of memory
amniotic fluid:	liquid that surrounds unborn child within the membranes inside the uterus
amputate:	to cut from the body
analgesia:	relief from pain
anaphylaxis:	hypersensitivity to substances following prior exposure, resulting in a severe allergic reaction
anemia:	deficiency in red blood cells
anesthesia:	loss of sensation
aneurysm:	abnormally dilated blood vessel
angina pectoris:	episodic chest pain caused by insufficient oxygen supply to the heart
antibiotic:	drug used to kill bacteria
antibody:	body substance, produced by specialized cells, that combines with and neutralizes foreign substances or toxins
antiemetic:	drug used to control nausea and vomiting
antihistamine:	drug used to inactivate histamine
antiinflammatory:	drug used to prevent or correct inflammation
antiseptic:	substance that limits or stops the growth of microscopic germs
antivenom:	drug used to inactivate the effects of animal or insect venom
anus:	posterior opening from the intestine to the outside world

aorta:	the large artery that carries oxygenated blood from the heart to be distributed to the body
aortic:	pertaining to the aorta
appendectomy:	surgical removal of the appendix
appendicitis:	inflammation of the appendix
appendix:	wormlike appendage of the bowel, located in the right lower quadrant of the abdomen
aqueous:	mixed with or related to water
arachnoid:	middle layer of membranes that cover the brain and spinal cord
argasid:	related to soft ticks
arrest:	sudden stop
arterial:	pertaining to an artery
arteritis:	inflammation of an artery
artery:	muscular- and elastic-walled blood vessel that carries oxygenated blood from the heart to the body
arthritis:	inflammation of the joints
arthropod:	invertebrate animal with jointed limbs belonging to the phylum Arthropoda; insect, spider, or crustacean
aspirate:	to draw by suction; to inhale into the lungs
asthma:	labored breathing caused by narrowing of the smaller air passages (past the bronchi) in the lungs, associated with shortness of breath, wheezing, cyanosis, and coughing
atherosclerosis:	hardening of the arteries
aura:	a sensation of lights or sounds that occurs before a migraine headache or seizure
barotitis:	disorder of the ear due to increased or decreased atmospheric pressure
bile:	green fluid produced by the liver and stored in the gallbladder, where it is released into the duodenum to aid in the digestion and absorption of fats
bilirubin:	a pigment formed from the destruction of red blood cells
biopsy:	the process of removing tissue from living creatures for diagnostic examination
blisters:	fluid-filled elevation of the epidermis
borreliosis:	related to microorganisms of the genus <i>Borrelia</i> , which transmit diseases such as Lyme disease
bowel:	intestine
brainstem:	part of the central nervous system between the spinal cord and brain, which controls certain critical functions, such as breathing
breech:	buttocks first, as in breech birth
bronchitis:	inflammation of the bronchial tree

bronchoconstriction:	narrowing of small airways, often caused by smooth muscle contraction
bronchodilator:	drug used to relax and widen the bronchi
bronchus:	main passageway from the trachea to the smaller air passages in the lungs
bruise:	injury that does not break the skin, with rupture of small blood vessels that causes blue or purplish discoloration
bursa:	fluid-filled sac that allows smooth motion of muscles or tendons over a bone or joint
bursitis:	inflammation of a bursa
buttocks:	the seat of the body; the rump
calorie:	the amount of energy necessary to raise the temperature of 1 g of water by 1°C; 1 food calorie ("kilocalorie") is equal to 1,000 energy calories
cancer:	malignant tumor; uncontrolled growth of cells that invade normal body tissues for no reason and serve no purpose
canker sore:	small, painful ulcer of the mouth
cannula:	small tube for insertion of fluid or air
capillary:	microscopic blood vessel that connects an artery to a vein
carbonaceous:	rich in carbon; black like soot
carbon dioxide:	gas that combines with water to form carbonic acid; formed by the combustion and decomposition of organic substances
cardiac:	pertaining to the heart
cardiopulmonary:	pertaining to the heart and lungs
carotid artery:	chief artery that travels up the neck and carries blood to the head and brain
carpal:	relating to the wrist
cartilage:	elastic tissue that is transformed into bone
cartilaginous:	composed of cartilage
cataract:	opacity in the lens of the eye
caustic:	corrosive; capable of destroying by chemical action
cellulitis:	inflammation of tissue, such as the skin
central nervous system:	the brain and spinal cord
cerebral:	pertaining to the brain
cervical:	pertaining to the neck
chilblain:	inflammation, swelling, and blistering of the skin caused by exposure to cold
cholecystitis:	inflammation of the gallbladder
cholelithiasis:	condition of having stones present in the gallbladder

chronic:	of long duration
colic:	acute pain caused by spasm, obstruction, or twisting of a hollow organ
colitis:	inflammation of the colon
colon:	the large intestine
coma:	a state of profound unconsciousness
comatose:	in a coma
comminuted:	in multiple pieces; shattered
compound fracture:	broken bone accompanied by torn skin
conjunctiva:	membrane that covers the insides of the eyelids and extends over the whites of the eyes
convulsion:	seizure; abnormal involuntary contraction or series of contractions of the muscles
COPD:	chronic obstructive pulmonary disease, caused by scarred lung tissue
core:	center; involving the abdomen and chest organs
cornea:	the transparent covering of the eyeball over the iris and pupil that allows light to enter the eye
corticosteroid:	one of a number of hormones produced by the adrenal glands
costochondritis:	inflammation of the cartilage that attaches the ribs to the sternum
CPR:	cardiopulmonary resuscitation, with artificial breathing and chest compressions
cravat:	triangular cloth bandage folded into a longitudinal strap
crepitus:	a crackling sound or feeling
culture:	to grow in a prepared laboratory medium
cyanosis:	blue or purple discoloration of the skin due to inadequate oxygen in the blood
cyst:	an abnormal sac containing gas, fluid, or solid material
debridement:	surgical removal of torn, contaminated, or devitalized tissue
decompression:	loss of pressure; contributes to diving-related bends
DEET:	active ingredient of many insect repellents; N,N-diethyl-3-methylbenzamide
dehydration:	depletion of body fluids
dermatitis:	inflammation of the skin
dermis:	layer of skin just underneath the epidermis that contains sensitive nerve endings, blood vessels, and hair follicles
diagnose:	to identify a disease
diaphragm:	muscular wall that separates the chest from the abdomen
dilation:	stretching to normal or beyond normal dimensions
dinoflagellate:	marine plankton
discharge:	liquid released from an organ or tissue surface

dislocation:	displacement of bones at a joint
disseminated:	spread over a wide area
distal:	at the end of; in the area farthest from the center of the body
diuretic:	drug that promotes urination
diverticulitis:	inflammation of a diverticulum
diverticulum:	small outpouching from a hollow organ (such as the large intestine)
dressing:	bandage; covering for a wound
duodenum:	first part of the small intestine
ectopic:	at a remote site; in the wrong place
edema:	swelling caused by the accumulation of fluid
electrolyte:	soluble inorganic chemical (such as sodium or potassium) found in body fluids
embolism:	sudden obstruction of a blood vessel by an embolus
embolus:	abnormal particle (such as a blood clot or air bubble) circulating in the bloodstream
encephalopathy:	disease of the brain that often results in abnormal mentation
encyst:	to completely surround with a membrane
endemic:	native to
endotracheal:	through the trachea
envenom:	to poison with venom
epidermis:	outermost layer of the skin
epigastrium:	area lying over the stomach; central upper area of the abdomen
epiglottis:	soft tissue pillar in the throat that covers the vocal cords and keeps food and liquid from entering the trachea during swallowing
epiglottitis:	inflammation of the epiglottis
epilepsy:	disorder associated with disturbed electrical discharges in the central nervous system that cause convulsions
epinephrine:	most potent hormone that stimulates increased heart rate and force of contraction, relaxation of smooth muscle in the airways that causes bronchoconstriction (during asthma or an allergic reaction), and constriction of microscopic blood vessels
epistaxis:	nosebleed
eruption:	a breaking out, particularly the appearance of redness, rash, blisters, sores, or other lesions of the skin
erythema:	redness
esophageal reflux:	return of food and acid from the stomach into the esophagus; major cause of heartburn
esophagitis:	inflammation of the esophagus
esophagus:	muscular tube from the pharynx to the stomach

eustachian tube:	a tube of bone and cartilage that connects the middle ear with the upper throat and allows equalization of pressure on both sides of the eardrum
exhale:	to breathe out
expectoration:	sputum, phlegm, or mucus; the act of spitting out saliva or mucus from the air passages via the mouth
extend:	lengthen; reach out
extremity:	arm and hand (upper extremity) or leg and foot (lower extremity)
facial:	pertaining to the face
fallopian tube:	small tube that conducts the egg from the ovary to the uterus
fascia:	tough, fibrous tissue that surrounds muscle bundles
fasciitis:	inflammation of the fascia
feces:	solid human bodily waste discharged through the anus
feculent:	pertaining to or resembling feces
femoral artery:	large artery that carries blood to the leg
femur:	large bone of the thigh
fetus:	unborn young after it has taken form in the uterus
fibrillation:	unsynchronized quivering
flagellate:	possessing a flagellum
flagellum:	whiplike organelle (tail) for locomotion
flail chest:	series of detached ribs that cannot move properly to assist with breathing
flatulence:	the presence of excessive gas in the bowel
flatus:	gas generated in the digestive tract and discharged via the anus
flex:	bend; fold
fluorescence:	the reemission of light (usually lower frequency) following its absorption; this is usually most apparent when the absorbed light is in the (invisible) ultraviolet range and the reemitted light is in the visible range
fluorescent:	possessing fluorescence
follicle:	skin cavity in which a root of hair lies
fracture:	to break; a broken object
frostbite:	freezing of the tissues
gallbladder:	muscular, hollow organ that stores bile produced by the liver
gangrene:	tissue death due to loss of blood supply; may be caused by injury or infection
gastroenteritis:	inflammation or irritation of the stomach and/or intestine
gastrointestinal:	pertaining to the stomach and intestine; digestive system
gauge:	the diameter of a hypodermic needle expressed as a standard number
genitals:	external organs of reproduction

gland:	a specialized group of cells that selectively removes substances from the blood, concentrates or alters substances in the blood, and/or creates and releases special substances into the blood
glaucoma:	disease of the eye associated with increased pressure within the eyeball
glucose:	type of sugar used by the body for energy
gonorrhea:	sexually transmitted disease caused by the bacterium <i>Neisseria gonorrhoeae</i>
graft (skin):	piece of skin taken from one area of the body to cover a defect or burn in another area
grain:	a measure of weight equal to 0.0648 g
gram:	a measure of weight equal to 15.432 grains
grand mal seizure:	convulsion manifested by violent generalized muscle contractions, clouded consciousness, and a period of confusion after the event
hallucinate:	to see visions or experience lack of reality
hallucination:	imaginary perception
heartburn:	burning discomfort behind the sternum related to irritation or spasm of the lower portion of the esophagus
Heimlich maneuver:	technique for removal of a foreign object caught in the upper airway
helminth:	intestinal worm-shaped parasite
hemoglobin:	iron-containing, oxygen-carrying pigment in red blood cells
hemorrhage:	bleeding
hemorrhoid:	dilated vein found at the anal margin
hepatitis:	inflammation of the liver
hernia:	protrusion of part or all of an organ through a wall of the space in which it is normally contained
hiatal hernia:	protrusion of part of the stomach through the diaphragm
histamine:	chemical compound that plays a major role in allergic reactions
HIV:	human immunodeficiency virus
hives:	raised red skin wheals associated with allergic reactions
hormone:	chemical substance formed in the body that is carried in the bloodstream to affect another part of the body; an example is thyroid hormone, produced by the thyroid gland in the neck, which affects growth, temperature regulation, metabolic rate, and other body functions
hydrate:	to cause to take up water
hygiene:	the science or practice of preserving health
hyper- (prefix):	excessive
hyperbaric:	pertaining to increased atmospheric pressure

hyperextension:	accentuated extension or straightening of a limb
hypertension:	elevated blood pressure
hyperthermia:	elevated core body temperature
hypertrophy:	enlargement of; excessive size
hyphema:	collection of blood in the chamber of the eye between the lens and the cornea (anterior chamber)
hypo- (prefix):	insufficient; underneath
hypodermic:	under the skin
hypoglycemia:	low blood sugar
hyponatremia:	low blood sodium
hypothermia:	low core body temperature
ileum:	the last (and longest) segment of the small intestine
ileus:	profoundly decreased physiological activity (motility) of the bowel, characterized by dilation, abdominal pain, and vomiting
iliac:	pertaining to the ilium
ilium:	the upper bone that forms the side of the pelvis
immobilize:	to prevent freedom of movement
immune:	not susceptible to
immunity:	condition of being able to resist a certain entity or disease
immunization:	the process of developing immunity; often refers to an injection
impetiginize:	to involve with impetigo
impetigo:	contagious skin disease caused by <i>Staphylococcus</i> or <i>Streptococcus</i> bacteria, characterized by weeping, crusting, and areas of pus formation
incarcerate:	to confine; to entrap
infarction:	area of tissue death caused by obstruction of blood circulation
inflammation:	response to cell injury that involves dilation of small blood vessels, redness, warmth, pain, and migration of white blood (pus) cells to the region; part of the healing process that removes noxious substances and damaged tissue; can be destructive as a primary disease process
infrared:	light that lies outside of the visible spectrum, with wavelengths longer than those of red light
inhale:	to breathe in
inspiration:	the act of breathing in
intestine:	the digestive tube that passes from the stomach to the anus; the small intestine (bowel) consists of the duodenum, jejunum, and ileum; the large intestine (bowel) consists of the cecum (with attached appendix), colon (ascending, transverse, descending, and sigmoid), and rectum
intoxication:	state of poisoning
intravenous:	into a vein
irrigate:	to rinse

ischemic:	in a condition of lowered blood flow; lacking sufficient oxygen to sustain function
-itis (suffix):	inflammation of
jaundice:	yellow pigmentation of the tissues and body fluids
jejunum:	the segment of the small intestine that follows the duodenum and precedes the ileum
ketoacidosis:	condition of excessive ketones in the bloodstream, associated with increased systemic acidity; a life-threatening condition of diabetics
ketone:	acid by-product of metabolism
kg (abbreviation):	kilogram
kilo- (prefix):	one thousand of something
kilocalorie:	1 food calorie, or 1,000 energy calories; the energy necessary to raise the temperature of 1 kg of water by 1°C
kilogram:	1,000 g; 2.2 lb
lacerate:	to tear or cut roughly
larva:	wormlike form of an insect that issues from the egg; grub, maggot, or caterpillar
larynx:	the portion of the trachea that contains the vocal cords; the voice box
lateral:	away from the midline; outer
lb (abbreviation):	pound
lethargy:	drowsiness or aversion to activity, caused by disease
ligament:	fibrous connective tissue that attaches bone to bone
liter:	volume of water that weighs 1 kg; 1.0567 quarts
localized:	confined to a specific area
lumbar:	pertaining to the lower back
lymph:	amber nutrient fluid that contains white blood cells; it circulates in the lymphatic system and is involved with injuries, infections, and cancers
lymphatic:	related to lymph glands, cells, or fluid; small vessel that transports lymph fluid
lymph node:	collection of lymph cells that function as a gland; node (colloquial)
malleolus:	rounded bony prominence, such as occurs on either side of the ankle
mandible:	lower bone of the jaw
manipulate:	to move mechanically, usually with the hands
melena:	dark-colored, tarry stools (feces), due to the presence of blood altered by intestinal fluids
meningitis:	inflammation of the covering of the brain and upper spinal cord
menses:	periodic hemorrhage from a woman's uterus that occurs most commonly at 4-week intervals
menstrual:	related to menses

menstruation:	periodic discharge of bloody fluid from the uterus
mental status:	condition of alertness and comprehension
metabolism:	the energy-producing and energy-utilizing processes that occur in the human body
mg (abbreviation):	milligram
micron:	measure of length equal to one one-millionth of a meter
microorganism:	small life form that requires a microscope to be seen
microscopic:	very tiny; requires a microscope to be seen
migraine:	recurrent severe headaches generally accompanied by an aura (classic migraine), nausea, vomiting, and dizziness
milli- (prefix):	one one-thousandth
milligram:	1/1,000 of a gram
milliliter:	1/1,000 of a liter
mL (abbreviation):	milliliter
mononucleosis:	infectious disease characterized by an abnormal increase in monocytes (a type of white blood cell) in the blood, weakness, fever, sore throat, and enlargement of the spleen and lymph nodes in the neck
mottled:	covered with colored spots or blotches
mucus:	slippery secretion created by mucous glands associated with mucous membranes (such as those that line the nose, throat, and mouth) for lubrication and some protection against bacteria
myocardial:	pertaining to the heart muscle
myoglobin:	iron-containing, oxygen-carrying pigment present in muscle tissue
myoglobinuria:	condition of having myoglobin present in the urine
nanometer:	one one-billionth of a meter
narcosis:	altered mental status ranging from confusion to coma
nebulize:	to reduce to a fine spray
neurologic:	pertaining to the nervous system
nm (abbreviation):	nanometer
nonsteroidal:	not containing steroids
organ:	part of the body with a specific function
otitis:	inflammation or infection of the ear
ounce:	measure of weight equal to 28.35 g; 1/16 lb
ovary:	one of two reproductive glands in a female that produces the female sex cells ("eggs")
ovulation:	release of an egg from the ovary
oxygen:	colorless, odorless gas necessary for combustion and life
oxyginate:	to supply with oxygen
oz (abbreviation):	ounce
ozone:	triatomic form of oxygen (O ₃) that is formed by electric discharge through air

pallor:	pale skin color
palpate:	feel with the hands
palpation:	the act of feeling with the hands
palpitation:	abnormal beating of the heart felt by the victim
pancreas:	gland that produces and secretes digestive enzymes (juices) and the insulin hormone
pancreatitis:	inflammation of the pancreas
parasite:	an animal or vegetable that lives on or in another and that draws its nourishment from the host
paroxysmal:	sudden
pediatric:	pertaining to children
pelvic:	related to the pelvis
pelvis:	strong, basin-shaped bone structure that provides support for the spine, hips, and legs
penile:	related to the penis
peptic:	related to digestive fluids
perineum:	area of skin situated between the external genitalia and the anus; area between the thighs extending from the tailbone to the front of the pubis
peristalsis:	natural contractions of the muscular walls of the bowel that move bowel contents forward
peritoneum:	lining of the abdominal organs and cavity
peritonitis:	inflammation of the peritoneum
petit mal seizure:	form of epilepsy characterized by brief periods of confusion without major abnormal muscle activity
pharyngitis:	inflammation of the pharynx; sore throat
pharynx:	throat
phlegm:	mucus secreted in the respiratory passages
photophobia:	aversion to light
photosensitivity:	sensitivity to light, particularly to ultraviolet radiation
pigment:	coloring matter or stain
placenta:	organ implanted within the uterus that supports an unborn child, which is attached by the umbilical cord
plankton:	microscopic plant life found in natural bodies of water
plantar:	on the bottom
platelet:	cellular component of the blood that contributes to clotting
pleura:	lining that covers the lungs and the inside of the chest cavity
pleural space:	a small space between the pleura that covers the lung and that lines the inside of the chest wall; normally, this space is minuscule (cannot be seen) because it is filled with negative pressure, which allows the lung to expand with the chest wall
pleuritis:	inflammation of the pleura
pneumonia:	infection of the lung characterized by fever, cough, shortness of breath, and the production of purulent or bloody sputum

pneumothorax:	collapsed lung with air in the pleural space
potable:	drinkable (preferably, disinfected)
prognosis:	projected outcome
prolapse:	to fall or sink down
prone:	lying flat with the face down
prophylactic:	for the purpose of prophylaxis
prophylaxis:	measures designed to maintain health and to prevent disease
protozoan:	microscopic unicellular or acellular animal
proximal:	closer to starting point or center; nearest to central part of the body
pubic:	pertaining to the region of the pubis
pubis:	the lowermost and anterior bone of the pelvis
pulmonary:	pertaining to the lungs
punctate:	like a dot or small mark
pupil:	contractile round opening in the center of the iris of the eye through which light is transmitted to the lens
purulent:	foul
pus:	white, yellow-green, or beige creamy fluid that is formed by decomposing tissue, white blood cells, and tissue fluids
pyelonephritis:	inflammation of the kidney due to a bacterial infection
quadrant:	one of the four quarters into which a region can be divided
radial artery:	the main artery that travels through the wrist to supply the hand
radiation:	emission of energy in the form of waves or particles
radiation of pain:	pain that travels from one region to another, such as from the hand to the shoulder
rebound tenderness:	pain in the abdomen that is worse on release of pressure than it is on creation of pressure (compression); often indicates peritonitis
recompression:	the method whereby increased atmospheric pressure is used to treat victims of air embolism or decompression sickness (diving-related disorders)
reflux:	backward flow
reflux esophagitis (heartburn):	inflammation of the esophagus caused by backward flow of acid from the stomach
relapse:	return of a disease after it has spent its course

renal:	related to the kidney
respiratory:	pertaining to the organs of breathing or the act of breathing
resuscitate:	to revive from death or unconsciousness
retina:	the posterior inside surface of the eye, which receives a light image refracted through the cornea and lens, and transmits it to the brain via the optic nerve
rigor mortis:	stiffening of the body that begins a few hours after death and that disappears from 1 to 5 days later, when decomposition begins
saline:	salty (solution); normal saline (liquid compatible with most human tissues) is 0.9% sodium chloride in water to soak; to dissolve to the highest possible concentration
saturate:	to bring under the influence of a sedative
sedate:	the act of calming
sedation:	calming or quieting; a drug or other substances that decreases nervous excitement
sedative:	epileptic convulsion
seizure:	the fluid component of blood after the cells are removed
serum:	a clinical state manifested by profound depression of all body functions, caused by insufficient blood and nutrient supply to the tissues; signs and symptoms include low blood pressure, cool and clammy skin, altered mental status, and collapse
shock:	silicon dioxide
silica:	body tissue that is not composed of bone or cartilage; generally refers to skin, muscle, and fat; generally excludes internal organs
soft tissue:	involuntary muscular contraction
spasm:	muscular ring that serves as a junction between two tubes, such as the esophageal sphincter (between the esophagus and stomach)
sphincter:	curled or spiraled microorganism capable of causing infectious disease
spirochete:	incomplete stretching or tearing of ligaments
sprain:	phlegm composed of saliva and discharges from the respiratory passages
sputum:	unchanging situation, such as status asthmaticus (severe, unchanging asthma), or status epilepticus (nonceasing convulsions)
status:	uncontaminated by infectious agents
sterile:	prominent neck muscle that connects the mandible to the collarbone and sternum
sternocleidomastoid:	breastbone
sternum:	

steroids:	hormones, vitamins, body constituents, and drugs with a specific chemical structure
strain:	incomplete stretching or tearing of tendons or muscles
stridor:	harsh vibrating noise heard in the upper airway during breathing; commonly associated with an outflow obstruction during exhalation; may be inspiratory
stroke:	cerebral hemorrhage, thrombosis, vasospasm, or embolism characterized by some degree of paralysis; also called apoplexy
sub- (prefix):	underneath
subarachnoid:	under the arachnoid
subconjunctival:	under the conjunctivae
subcutaneous:	under the skin
sublingual:	under the tongue
supine:	lying flat with the face up
supraventricular:	above the level of the ventricles (lower chambers) of the heart
suture:	to sew with surgical thread or nylon; the thread or nylon used to sew a wound closed
symphysis:	a barely movable junction of two bone surfaces connected by a fibrous cartilage pad
syndrome:	a collection of signs and symptoms that, taken together, constitute a particular disease or abnormality
synthesize:	to create or compose
syringe:	device used to inject fluids into or remove them from the body
systemic:	affecting the entire body
tachycardia:	rapid heart rate (beat)
tendon:	fibrous tissue that attaches muscle to bone
tension pneumothorax:	collapsed lung under pressure from air in the pleural space
testis:	one of two male reproductive glands located in the scrotum
testicle:	testis
tetanus:	an infectious disease caused by the bacterium <i>Clostridium tetani</i> , characterized by severe muscle contractions and inability to open the mouth (lockjaw); the bacterium that causes tetanus
thermal:	pertaining to heat
thermoregulatory:	in control of temperature
thrombophilia:	increased number of platelets
thrombophlebitis:	an inflammation of the veins that causes the formation of blood clots
thrombosis:	formation of a thrombus

thrombus:	clot formed in a blood vessel or in one of the cavities of the heart
tinnitus:	noises, such as ringing, in the ears
tissue:	a group of cells that combine in the body to serve a specific function
tourniquet:	a device used to control blood flow by impeding or preventing circulation
toxin:	poisonous substance
trachea:	main passageway for air from the pharynx to the bronchi
tracheostomy:	surgical opening created in the neck into the trachea to allow breathing when the upper airway is obstructed
trauma:	mechanical injury
traumatic:	related to mechanical injury
triage:	sorting of patients by priority
tubal:	related to a tube
tumor:	abnormal growth of tissue that arises in the body without purpose; may be benign (noncancerous) or malignant (cancerous)
tympanic membrane:	eardrum
ulcer:	erosion; open sore
ultrasonic:	beyond the normal range of sound waves
ultraviolet:	light outside of the violet end of the visible spectrum with a wavelength shorter than that of visible light
umbilical:	relating to the umbilicus
umbilicus:	navel; belly button; pit in the center of the abdominal wall where the umbilical cord was attached to the fetus before birth
unconscious:	unaware; unarousable
ureter:	muscular tube that carries urine from the kidney to the bladder
urethra:	passage that carries urine from the bladder to the external opening in the genital region
urogenital:	genitourinary; pertaining to the urinary tract and genitalia
urticaria:	itchy, patchy, raised, and red skin rash, often associated with allergy
uterus:	muscular reproductive female organ in which a child develops; womb
vaccinate:	to inject a special preparation for the purpose of achieving immunity from disease
vaginitis:	irritation of the vagina
varicose:	abnormally swollen or dilated
vascular:	pertaining to the blood vessels
vasospasm:	contraction of a blood vessel, often caused by microscopic muscle contraction

- vein:** blood vessel that carries blood from the body back to the heart
- venom:** poison secreted from venom glands in animals and insects; usually introduced into the victim with a bite or sting
- venous:** pertaining to the veins
- ventricle:** one of two large chambers of the heart
- vertebra:** one of the bony segments that form the spinal column (backbone)
- vertigo:** dizziness; sensation of whirling motion
- vessel:** container; a blood vessel may be an artery, vein, or capillary
- vitreous:** gelatinous fluid within the eye
- wheezing:** labored breathing, usually noted on expiration, associated with lung disorders characterized by airway narrowing, such as asthma

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